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A
COMPLETE TREATISE OF
LAND SURVEYING,
BY THE
CHAIN, CROSS,
AND
OFFSET STAFFS ONLY.

IN THREE PARTS, VIZ.

PART I.

Teaches all the uſeful Definitions and Problems in Geometry, requiſite in Land Surveying: likewiſe Plain Trigonometry, with its Application in Meaſuring inacceſſible Heights and Diſtances.

PART II.

How to Meaſure with the Chain, only aſſiſted as above, and caſt up the Dimenſions thereof by the Pen alone, with the Method to Plan all kinds of Incloſures: likewiſe to Survey an Eſtate, Manor, &c. by the ſame Inſtruments; with the invaluable Method of caſting up the Dimenſions by the Pen, and afterwards to Plan, Map, and Embelliſh the ſame. Alſo, ſheweth the Method to Meaſure Woods, Water, or any inacceſſible Grounds whatſoever: with the Method of dividing and laying out Land, reducing Plots, &c.

PART III.

The Practical Method of Meaſuring Hayricks, Marl Pits, and Timber; alſo all kinds of Artificer's Work---the Manner of taking Dimenſions with the cuſtomary Additions and Deductions; likewiſe the Method of Levelling or Conveying of Water from one Place to another.

The whole explained in a clear and perſpicuous Manner.

By WILLIAM DAVIS,

AUTHOR OF THE USE OF THE GLOBES, LATELY PUBLISHED, AND MEMBER
OF THE PHILOSOPHICAL SOCIETY, LONDON.

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MVSEVM
BRITAN
NICVM

PREFACE.

IF we conſult the writings of the ancients, they will inform us that this art, for it's antiquity, is nearly as old as the world. We find the Egyptians, by reaſon of the overflowing of the Nile, which either waſhed away their land marks, or covered them with mud, were conſtrained by neceſſity to invent ſome means or other, whereby each one every year might repoſſeſs his property; hence it was looked upon, by moſt authors, that the Egyptians were the firſt inventors of Land Surveying.

It being ſo pleaſant and delightful a ſtudy, the exerciſe ſo wholeſome, together with the great uſefulneſs that attended it, it prevailed on ſo many to apply themſelves to this art, that, at length, in Egypt every youth could meaſure land. The uſefulneſs of this art influenced

Thales to convey it into Greece, where it was called Geometry; but that being too comprehenſive a term for the menſuration of ſuperficies only, it was afterwards called The Art of Meaſuring Land.

The ancient and learned Romans held this art in ſo high eſteem, that they adjudged any man incapable of commanding a legion, that had not at leaſt ſo much geometry as would enable or qualify him to meaſure a field; nor did they reſpect either prieſt or phyſician that had not ſome inſight of the mathematics.

I have laid this treatiſe down in the plaineſt manner poſſible, to render it perfectly eaſy to the meaneſt capacity; for I have inſerted the moſt irregular occurrences that can poſſibly be met with in practical ſurveying. If any latent or inſignificant erratum be met with, I hope the candid reader will paſs over it as a caſual overſight.

I have likewiſe given, in Part the Third, the method of levelling or conveying water from one place to another; with the practice of meaſuring hayricks, marl pits, and timber; alſo artificers' work.

But, to conclude, the neceſſity there is for a complete eaſy treatiſe of land ſurveying, will I hope, be deemed a motive ſufficient for my uſhering this treatiſe into the world; and ſhould it happily meet with the approbation of my kind readers, and the public in general, it will amply fulfil the ſincere deſire of

THE AUTHOR.

London, July 10th, 1798.

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LAND SURVEYING, &c.

PART I.

Containing ſo much Geometry as Surveying requires.

GEOMETRICAL DEFINITIONS.

GEOMETRY originally ſignifies the art of meaſuring the earth, or any diſtance or dimenſions on or within it. But it is now uſed for the ſcience of quantity, extenſion, or magnitude, abſtractly conſidered, without any regard to matter.

Geometry very probably had it's firſt riſe in Egypt, where the Nile annually overflowing the country, and covering it with mud, obliged men to diſtinguiſh their lands one from another, by the conſideration of their figure; and to be able alſo to meaſure the quantity of it, and to know how to plot it, and to lay it out again in it's juſt dimenſions, figure, and proportion: after which, it is likely, a farther contemplation of thoſe draughts and figures helped them to diſcover many excellent and wonderful properties belonging to them; which ſpeculation continually was improving, and is at this very day.

Definition 1. A point is that which hath no parts, as A, fig. 1. See plate 1.

2. A line is generated, or produced, by the motion of a point, and is the bound of a ſuperficies, and may be repreſented by the motion of a pen by the edge of a ruler, as from A to B, fig. 1. It is either right when it is the ſhorteſt diſtance between the two points A and B; or curved, when it is not the ſhorteſt diſtance between two points, as the line CD.

3. The extremes, limits, terms, or ends of a line are points.

4. A ſuperficies is generated by the motion of a line, and has two dimenſions, viz. length and breadth. A ſuperficies may be contained within one curve line, but of right lines it cannot be contained in leſs than three.

5. An angle is formed by the inclination of two lines, AB and AC, one towards another, meeting in a point A, and forming the angle A, fig. 2.

6. And that point, A, is called the angular point.

7. When a right line AB, ſtandeth upon a right DC, making the angles CAB and DAB on each ſide equal, the line AB ſo ſtanding, is perpendicular to the line CD, upon which it ſtandeth, fig. 3.

8. A right angle contains 90°, as DAB in fig. 3.

9. An acute angle leſs than 90°, as CAE, fig. 3.

10. And an obtuſe angle more, as DAE, fig. 3.

11. A plain triangle is a figure or ſuperficies bounded by three right lines; and of which there are the following ſorts:

Firſt, An equilateral triangle is that whoſe bounds or ſides are all equal, as ABC, fig. 4.

Second, An iſoceles triangle is, when only two ſides are equal, as ABC, fig. 5.

Third, A ſcalene triangle is, when all the three ſides are unequal, as ABC, fig. 6.

Fourth, A right angled triangle is that which has one right angle, whereof the ſide AC, oppoſite to the right angle, is called the hypothenuſe, as fig. 7.

12. A ſquare is a four-ſided figure, whoſe ſides are all equal; and it's angles right ones, or each equal to 90 degrees, as, ABCD, fig. 8.

13. A rectangle is vulgarly called an oblong, or long ſquare, whoſe oppoſite ſides are equal and parallel, but longer than it is broad, containing four right angles, as ABC, fig. 9.

14. A rhombus is a four-ſided figure, having all it's ſides equal, and the oppoſite angles equal, but not right ones, two being acute, and two obtuſe, as ABCD, fig. 10.

15. A rhomboides is a rectangle out of form, whoſe oppoſite ſides are equal and parallel, but longer than it is broad, containing no right angle, as fig. 11.

16. A trapezium is a four-ſided figure, having all it's ſides, as well as angles, unequal, as ABCD, fig. 12.

17. A diagonal line is a right line drawn from, or between, the oppoſite angles in all quadrangle figures, as the line BD, fig. 12.

18. Multangular, multilateral, and polygonical figures, are ſuch as are comprehended under many lines, as ABCDEFGHIK, fig. 13.

19. A circle is a plain comprehended under one line, called a periphery, or circumference, into which all right lines, drawn from a point within the circle, are equal, as CBEDF, fig. 14. and that point is called the centre of the circle, as at A.

The diameter of a circle is a right line paſſing through the centre, and terminated on both ſides by the periphery, as CD.

A ſemicircle is that part of a circle that is comprehended under the diameter, as CFD.

A quadrant is the fourth part of a circle, or 90 degrees, as CBA.

An arch of a circle is any part of the periphery, as EDA, in the ſame figure.

GEOMETRICAL PROBLEMS.

PROBLEM I.

To biſect a given line into equal parts.

SUPPOSE the given line be AB, fig. 15. See plate 1; it is required to biſect the ſame. Open the compaſſes, or dividers, to any thing more than half the given line, and then with one leg or foot on the point B, deſcribe the arch De, above the line AB, and alſo below it; then ſhift your dividers, and, with one leg in the point A, deſcribe two arches with the ſame extent as before, that ſhall croſs or interſect the two former arches, in the points F and C, from which draw a line, and it will biſect the line AB in the middle thereof.

PROBLEM II.

To erect a Perpendicular at the End of a given Line.

Let DC, fig. 16, be the line, and at the point C, it is required to erect the perpendicular CB.

Open the compaſſes to any ordinary extent, and ſetting one foot in the point C, let the other fall at pleaſure (it is not material where) above the ſaid line, DC, as at the point O; then, without altering the extent of the compaſſes, one foot being in the point O, deſcribe the arch LL, and alſo another arch that will croſs the line DC in I; point the interſection, then lay a ruler, to point I and O, and draw the pricked line IG. Laſtly, From the point C, and through the interſection G, draw the line CGB, which will be perpendicular to the line DC.

PROBLEM III.

To erect a Perpendicular at a Point in a given Line.

The line given is AB, fig. 17, and at the point F, and it is required to erect a line, which ſhall be perpendicular to AB.

Open the compaſſes to any convenient width, ſetting one foot in the given point F, with the other make a mark in the line AB, as at EE, then take up your compaſſes, and open them ſomething wider than before, fixing one foot in either of theſe points E, deſcribe an arch above the line; then remove your compaſſes to the other point, with the ſame extent, and deſcribe an arch that ſhall interſect the former arch, through the point of interſection, and the given point F; draw a line, and it will be perpendicular to the given line AB.

PROBLEM IV.

To let fall a Perpendicular from a Point that is not in a given Line.

The given line is AB, fig. 18, and the point is at C, from which it is required to let fall the line C, that ſhall be perpendicular to AB.

In the given point C, ſet one foot of the compaſſes, and with the other deſcribe an arch, that ſhall croſs the line AB in the point c and e, and, by the firſt problem, biſect the diſtance between c and e, through which point of biſection, and the point c, draw a line, and it will be perpendicular to the given AB.

PROBLEM V.

To draw a Line parallel to a given Line through a Point given.

The given line is AB, fig. 19, and it is required to draw the line CD through the point E, that ſhall be parallel to the line AB.

From any part of the line AB, (ſuppoſe at F,) take the diſtance in the compaſſes between F and B, then ſetting one foot in the point E, with the diſtance FB, deſcribe the arch GG, then take in your compaſſes the diſtance between F and E, and ſetting one foot in the point B, croſs the arch GG, in the point I, through which, and the point E, draw the line CD, and it will be parallel to AB.

PROBLEM VI.

To make a Triangle of three given Lines, provided any two taken together be greater than the third. Euclid 22, book 1.

Suppoſe the given lines were 7, 8, and 9, fig. 20.

To conſtruct this or any triangular figure, (when three ſides are given,) you muſt firſt draw a line with ſcale and compaſſes parallel to your breaſt, and lay thereon one of your given lines, as from A to B.

Secondly, Take in your compaſſes, another given ſide, and fixing one foot in A, deſcribe an arch above the line; then remove your compaſſes to the point B, with the extent of the third given line, deſcribe an arch that ſhall interſect the former in the point C: and,

Thirdly, Draw lines from A to C, and from B to C, ſo ſhall you have the triangle conſtructed.

PROBLEM VII.

To make a Geometrical Square.

Suppoſe AB, *fig.* 21, be a line given, and it is required to conſtruct a ſquare, whoſe ſide ſhall be equal to the line AB.

Firſt, Draw a line equal to the given line, as from A to B; at the point B, by problem 2, erect the perpendicular BC, making BC equal to AB; then with one foot of your compaſſes in A, with the diſtance AB, deſcribe the arch D.

Secondly, With the ſame extent in your compaſſes as before, and one foot in C, deſcribe an arch that ſhall interſect the former arch in the point D.

And, *laſtly*, draw lines from the point D, to A and C, and the ſquare is completed.

PROBLEM VIII.

To make a Rectangle, or long Square.

This problem is not much unlike the former: admit, then, that two lines be given, viz. 4 and 8, and it be required to make a rectangle of them.

Firſt, Lay down the longeſt line, *to wit*, 6, and at the end thereof, viz. B, erect the perpendicular line BC, by problem 2, equal to 3 (your ſhorteſt line); then placing one foot of your compaſſes in C, with the diſtance AB, or 6, deſcribe an arch; then remove your compaſſes, placing one foot in A, with the diſtance BC, or 3, deſcribe another arch that ſhall interſect the former in point D.

And, *laſtly*, draw lines from D to A and C, which forms the rectangle ABCD, fig. 22.

PROBLEM IX.

Upon any given right Line to conſtruct a Rhombus.

Let AB be given, fig. 23, with the extent of AB in your compaſſes, and one foot in B, deſcribe the arch DC, with the ſame extent, and one foot of the compaſſes in A make the interſection at D; ſtill with the ſame extent, and one foot of the compaſſes in D, make the interſection at C; draw the right lines AD, DC, and CB, and it is done.

PROBLEM X.

Having any two right Lines given to conſtruct a Rhomboides.

Let the given lines be AB and CD, fig. 24; take in your compaſſes the ſhorteſt line CD, and ſet it on the longeſt line AB, from A to E, with the ſame extent, and one foot of the compaſſes in A and E ſeverally make the interſection D; with the ſame extent, and one foot of your compaſſes in B, deſcribe an arch C; with the extent of AB in your compaſſes, and one foot in D, interſect the former arch in C; draw the lines AD, DC, and CB, and it is done.

PROBLEM XI.

To conſtruct a Quadrilateral Figure, containing one obtuſe, one acute, and two right angles, three lines only being given, viz. the baſe and the two perpendiculars, which contain the right angles.

Let the lines given be 3, 4, and 5, fig. 25, and it be required with them to conſtruct a quadrilateral, or four-ſided figure. Let the line AB be laid down equal to the given line 5, and at the points A and B, erect the perpendicular AD and BC, by the ſecond problem, making AD equal to the line 3, and BC equal to 4; and, laſtly, draw a line from D to C, and it is done.

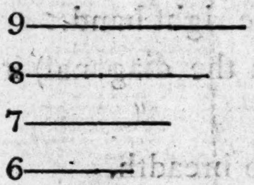
PROBLEM XII.

To conſtruct a Trapezium two different ways.

Firſt, With four given lines, viz. 6, 7, 8, 9, the ſides of the trapezium.

Secondly, With three given lines, viz. the diagonal and the two perpendiculars.

Let it be required to make a trapezium of the four following lines, fig. 26.



Firſt, lay down any one of the lines from A to B; ſuppoſe the line 9; then at the point B, make an accute angle at pleaſure, by drawing the line BL, equal to the line 8; then placing one foot of your compaſſes in the point L, with the diſtance of the line 7, deſcribe the arch nn; take up your compaſſes, and place one foot in the point A, with the diſtance of the line 6, deſcribe another arch that ſhall interſect the former in the point O; draw the lines AO, and LO, and it completes the trapezium ABLO. A trapezium made after or by this method, may be variouſly or differently repreſented, provided the angles are not given.

SECOND METHOD.

See fig. 27, the dimenſions are as follow:

At 0 —— 0 no breadth
5 —— 5 right hand
8 —— 4 left hand
12 —— 0 no breadth.

Firſt, At the beginning, that is no length, it is no breadth.

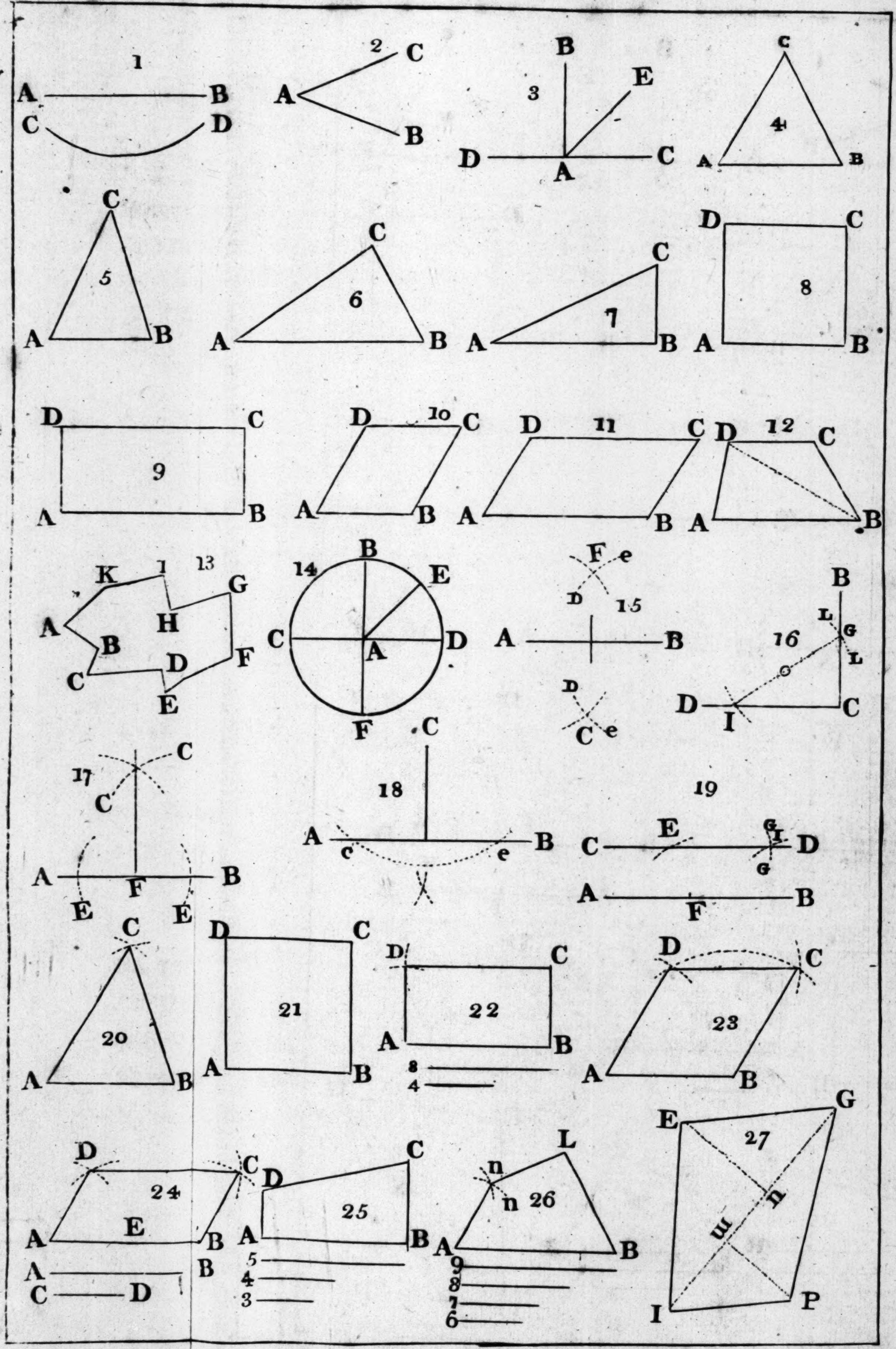
Secondly, At 5, it is 5 on the right hand.

Thirdly, At 8, (that is upon the diagonal) it is 4 to left hand.

And, *laſtly*, at 12 there is no breadth.

From theſe dimenſions a trapezium may be conſtructed with expedition and correctneſs, without regarding any of the angles, which muſt be conſidered in the firſt method, otherwiſe the reſult will admit of unlimited variety.

Plate 1


1
A
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C
D
2
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B
C
3
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B
C
D
E
4
A
B
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B
C
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C
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G
A
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F
20
A
B
C
21
A
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C
D
22
A
B
C
D
8
4
23
A
B
C
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24
A
B
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Firſt, At pleaſure draw a line with your compaſſes, and lay thereon your diagonal IG=12, then at 5 chains, or n (your diagonal being perpendicular to your breaſt, or how you will); upon the right hand ſide lay down the perpendicular nE=5; and at 8 chains, or m, lay down the perpendicular 4=mP to the left hand. Join the points IE, EG, GP, and PI, together, and it is done.

PLAIN TRIGONOMETRY.

PLAIN Trigonometry teaches the relations and calculations of the ſides and angles of plain triangles.

The angles of triangle are meaſured by the number of degrees contained in the arc cut off by the legs of the angle, and whoſe centre is the angular point. A right angle is, therefore, an angle of 90 degrees; and the ſum of the three angles of every triangle, or two right angles, is equal to 180°; wherefore in a right angled triangle, the one acute angle being ſubtracted from 90°, the remainder will be the other; and the ſum of any two angles of a triangle being taken from 180° will leave the third angle.

Degrees are marked at the top of the figure, a ſmall °, minutes with ′, ſeconds with ″, and ſo on, thus, 67° 29′ 42″, that is, 67 degree, 29 minutes, and 42 ſeconds.

In a right angled triangle, the ſide oppoſite the right angle is called the hypothenuſe; and the other the legs, or ſides, or ſometimes the baſe and perpendicular.

The complement of an arc is what it wants of a quadrant, ſo BC = 40°, is the complement of AB = 50°. See figure 1, plate 2.

The ſupplement of an arc is what it wants of a ſemicircle, ſo BCD = 130° is the complement of AB = 50°.

The ſine of an arc is the line drawn from one end of the arc, perpendicular upon the diameter, drawn through the other end of the arc, ſo BE is the ſine of AB or of BCD.

The verſed ſine of an arc is the part of the diameter between the ſine and the beginning of the arc, ſo AE is the verſed ſine of AB, and DE the verſed ſine of BCD.

The tangent of an arc is the line drawn perpendicularly from one end of the diameter, paſſing through one end of the arc, and terminated by the line drawn from the center through the other end of the arc, ſo AG is the tangent of AB, or of BCD.

The ſecant of an arc is the line drawn from the center through the end of the arc, and terminated by the tangent; ſo FG is the ſecant of AB, or of BCD.

The co-ſine, co-tangent, or co-ſecant of an arc, is the ſine, tangent, or ſecant of the complement of that arc; ſo BH is the co-ſine, CI the co-tangent, and FI the co-ſecant of AB.

From the definitions it is evident that the ſine, tangent, and ſecant are common to two arcs, which are the two ſupplements of each other; ſo the ſine, tangent, or ſecant of 50°, is alſo the ſine, tangent, or ſecant of 130°.

The ſine, tangent, or ſecant of an angle, is the ſine, tangent, or ſecant of an arc, or the degrees by which the angle is meaſured.

AXIOM I.

In all plane triangles, if the hypothenuſe be made radius, each leg will repreſent the ſine of its oppoſite angle (as BF, in the triangle of ABF, fig. 1, plate 2). But if either of the legs be made radius, the other leg will repreſent the tangent of its oppoſite angle, and the hypothenuſe the ſecant of the ſame angle.

To find a ſide, any ſide may be made radius, ſaying, as the word upon the given ſide, is to the given ſide; ſo is the word upon the ſide required, to the ſide required.

To find an angle, one of the given ſides muſt be made radius, ſaying, as the ſide made radius, is to radius; ſo is the other given ſide to the word upon it, whether ſine, tangent, or ſecant.

To work proportions by logarithms, obſerve this general rule:

Add the logarithm of the ſecond and third terms together, and from that ſum ſubtract the logarithm of the firſt term; the remainder is the logarithm of the fourth term, or number ſought. When an angle is greater than 90°, the ſine, tangent, and ſecant of the ſupplement is to be uſed.

PROBLEM I.

CASE I.

The angles and hypothenuſe given to find either of the legs.

The hypothenuſe AC 20 chains; the angle A 30 degrees, and conſequently the other at C is 60 degrees, being given to find the baſe AB, and perpendicular BC, is required. See fig. 2, plate 2.

CONSTRUCTION.

Draw the baſe line at pleaſure, as AB; then take from the ſcale of chords 60 degrees, and placing one foot in A, deſcribe the arch mn, and mark with the point of your dividers where it croſſeth the line AB, as at d, and from thence to c; lay off 30 degrees, taken from the ſame ſcale. Lay a ruler from A to c, and draw an occult line, upon which lay down 20 chains, taken from any ſcale of equal parts, viz. to C; let fall the perpendicular CB, which complete the triangle ABC. Fig. 2, plate 2.

BY CALCULATION.

To find the ſide AB.

As radius - - - - - - - - - -	10.00000
Is to the ſine of angle C 60° - -	9.93753
So is the hypothenuſe AC 20°	1.30103
	11.23856
	10.00000
To the ſide AB, 17 chains 32 links	1.23856

To find the ſide BC.

As radius - - - - - - - - - -	10.00000
Is to the ſine of angle A 30° - -	9.69897
So is the hypothenuſe AC20°	1.30103
	11.00000
	10.00000
To the ſide BC 10 chains - - -	1.00000

BY GUNTER's SCALE.

In all propoſitions wrought by Gunter's ſcale, when the firſt and ſecond terms are of the ſame kind, then the extent from the firſt term to the ſecond will reach from the third to the fourth; or when the firſt and third terms are of the ſame kind, the extent from the firſt term to the third will reach from the ſecond to the fourth; that is, ſet one point of your compaſſes on the diviſion expreſſing the firſt term, and extend the other point to the diviſion expreſſing the ſecond (or third) term; then, without altering the opening of the compaſſes, ſet one point on the diviſion repreſenting the third term (or ſecond term) and the other point will fall on the diviſion ſhewing the fourth term, or anſwer.

Extend from the radius, or 90° to 60°, the angle at C, on the line of ſines; that extent will reach from the hypothenuſe AC 20°, to the baſe AB 17 chains 32 links, on the line of numbers.

2dly. Extend from radius to 30°, the angle at A on the line of ſines; that extent will reach from the hypothenuſe AC 20°, to the perpendicular BC 10 chains, on the line of numbers.

PROBLEM II.

CASES II and III.

The angles and one leg given to find the hypothenuſe and the other leg.

The leg AB 17 chains 32 links, the angle A 30°, and the angle C 60°, being given to find the hypothenuſe and other leg. Fig. 3, plate 2.

CONSTRUCTION.

Draw the line AB, and lay thereon 17 chains 32 links, then at the point B erect the perpendicular BC. At the point A, with the chord of 60°, deſcribe the arch mn; then take the angle A 30° from off the line of chords, and lay it from m to c; then lay a ruler from A to c, and draw the occult line, which will croſs the perpendicular in the point C, and it is done.

BY CALCULATION.

To find the perpendicular BC.

As the ſine angle C 60° - - -	9.93753
Is to the baſe AB 17 chains 32 links	1.23856
So is the ſine angle A 30° - - -	9.69897
	10.93753
	9.93753
To the perpendicular BC 10 chains	1.00000

To find the hypothenuſe AC.

As the ſine angle C 60° - - -	9.93753
Is to the baſe AB 17 chains 32 links	1.23856
So is radius - - - - - - - -	10.00000
	11.23856
	9.93753
To the hypothenuſe AC 20 chains	1.30103

BY GUNTER.

Extend your compaſſes from 60 degrees the angle at C, to 30 degrees the angle at A, on the line of ſines; that extent will reach from the baſe AB 17 chains 32 links, to the perpendicular BC 10 chains, on the line of numbers.

2dly. Extend from 60 degrees to radius on the line of ſines; that extent will reach from the baſe AB 17 chains 32 links, to the hypothenuſe AC 20 chains, on the line of numbers.

PROBLEM III.

CASES IV and V.

The hypothenuſe and one leg given to find the angles and the other leg.

The hypothenuſe AC 20 chains, the perpendicular BC 10 chains, given to find the angle at A, and the angle at C, with the baſe AB. See fig. 4, plate 2.

CONSTRUCTION.

Make AB = 17 chains 32 links, and at the point B erect the perpendicular BC; then take in your dividers 20 chains the hypothenuſe, and ſetting one foot in the point A, deſcribe an arch that ſhall interſect the perpendicular in the point C; laſtly, join A and C together, and it is done.

BY CALCULATION.

To find the angle A.

As the hypothenuſe AC 20 chains	1.30103
Is to radius - - - - - - - -	10.00000
So is the perpendicular BC 10 chains	1.00000
	11.00000
	1.30103
To the ſine angle A 30° - - -	9.69897

To find the angle C.

As the perpendicular BC 10 chains	1.00000
Is to radius - - - - - - -	10.00000
So is the hypothenuſe AC 20 chains	1.30103
	11.30103
	1.00000
To the ſecant angle C 60° - -	10,30103

To find the baſe AB.

As radius - - - - - - - - - -	10.00000
Is to the hypothenuſe AC 20 chains	1.30103
So is the ſine angle C 60° - - -	9.93753
	11.23856
	10,00000
To the baſe AB 17 chains 32 links	1.23856

BY GUNTER.

Extend your compaſſes from the hypothenuſe AC 20, to the perpendicular BC 10, on the line of numbers; that extent will reach from radius to the ſine angle A 30 degrees, on the line of ſines, then 90° — 30° = 60°, the angle at C.

2dly. Extend from radius to ſine angle C 60 degrees, on the line of ſines; that extent will reach from the hypothenuſe AC 20, to the baſe AB 17 chains 32 links, on the line of numbers.

PROBLEM IV.

CASES VI and VII.

The legs given to find the angles and hypothenuſe.

Let the baſe AB 17 chains 32 links, the perpendicular BC 10 chains, be given to find the angles at A and C, with the hypothenuſe AC. See fig. 5, plate 2.

CONSTRUCTION.

Draw the line AB = 17 chains 32 links, and at the point B erect a perpendicular, upon which lay down 10 chains from B to C; then join AC, and it is done.

BY CALCULATION.

To find the angle A.

As the baſe AB 17 chains 32 links	1.23856
Is to radius - - - - - - - -	10.00000
So is the perpendicular BC 10	1.00000
	11.00000
	1.23856
To tangent angle A 30° - - -	9.76144

To find the angle C.

As the perpendicular BC 10 - -	1.00000
Is to radius - - - - - - - -	10.00000
So is the baſe AB 17 chains 32 links	1.23856
	11.23856
	1.00000
To the tangent angle C 60°	10.23856

To find the hpyothenuſe AC.

As radius - - - - - - - - - -	10.00000
Is to the baſe AB 17 chains 32 links	1.23856
So is the ſecant angle A 30°	10.06247
	11.30103
	10.00000
To the hypothenuſe AC 20 chains	1.30103

BY GUNTER.

Extend your compaſſes from the perpendicular BC 10, to the baſe AB 17 chains 32 links, on the line of numbers; that extent will reach from radius (or 45) to 30°, the angle A on the line of tangents, 90° — 30° = 60°, the angle at C.

2dly. The extent from 60°, the angle C to radius, on the line of ſines; that extent will reach from the baſe AB 17 chains 32 links, to the hypothenuſe AC 20 chains, on the line of numbers.

The three axioms that pertain to oblique plane triangles, with the ſix caſes thereof.

AXIOM II.

In all plane triangles, the ſides are in ſuch proportion, one to another, as are the ſines of their oppoſite angles; that is, as the ſine of any one angle is to its oppoſite ſide, ſo is the ſine of any other angle to its oppoſite ſide.

As any ſide is to the ſine of its oppoſite angle, ſo is any other ſide to the ſine of its oppoſite angle.

To find a ſide, begin with an angle; and to find an angle, begin with a ſide.

PROBLEM V.

CASE I.

Two angles and one ſide given to find either of the other ſides.

The angle at D 97° 30′, and B 35°, and the ſide BC 22 chains, given to find the ſides CD and BD. See fig. 6, plate 2.

CONSTRUCTION.

Make BC equal to 22 chains, and at B make an angle equal to 35°, thus: Take in your compaſſes the chord of 60°, and, with one foot in the point B, deſcribe the arch ab; on that arch lay 35°; from c to d, through the points B and d, draw the line Bd. From 180° take the ſum of the two angles given, viz. 97° 30′; add 35 = 132° 30′: the remainder is 47° 30′, the quantity of the angle at C. At C make an angle of 47° 30′, in like manner; that is, with the chordof 60° deſcribe the arch ef, and lay thereon 47° 30′, from G to h.

Laſtly. Through h draw the line Ch, that ſhall interſect the line Bd in D, and it is done.

The proportion by Axiom II, will be to find the ſide DC.

BY CALCULATION.

As the ſine of angle D 97° 30′	9.99627
Is to the ſide BC 22 chains - - -	1.34242
So is the ſine of angle B 35° - -	9.75859
	11.10101
	9.99627
To the ſide DC 12 chains 72 links	1.10474

To find the ſide BD *by the ſame Axiom.*

As the ſ. an. D 97° 30′	9.99627
Is to the ſide BC 22 ch.	1.34242
So is the ſine an. C 47° 30′	9.86763
	11.21005
	9.99627
To the ſide BD 16c, 36l.	1.21378

Add	97° 30′
	95
The ſ. of the ang. D & B	132 30
From	180
Take	132 30
Remains angle C	47 30
	180
	97 30
Supplement of angle D	82 30

BY GUNTER.

Extend your compaſſes from the ſupplement of angle D 82° 30′ to the angle B 35°, on the line of ſines; that extent will reach from the ſide BC 22 chains to 12 chains 72 links, on the line of numbers.

2dly. Extend from the ſupplement of the angle D 82° 30′ to angle C 47° 30′ on the line of ſines; that extent will reach from the ſide BC 22 chains, to the ſide BD 16 chains 36 links, on the line of numbers.

PROBLEM VI.

CASES II and III.

Two ſides and an angle oppoſite to one of them given to find the other oppoſite angle and third ſide.

The ſide BC 22 chains, BD 16 chains 36 links, and the angle C 47° 30′, given to find the angle at D and the ſide CD. See fig. 7, plate 2.

CONSTRUCTION.

Make the ſide BC 22 chains, and at the point C make an angle equal, 47° 30′, then take in your dividers to the other given ſide BD, equal 16 chains 36 links; ſetting one foot in point B, deſcribe an arch that ſhall interſect the line CD, in the point D; then join BD, and it is done.

BY CALCULATION.

To find the angle D.

As the ſide DB 16 chains 36 links	1.21378
Is to the ſine angle C 47° 30′ -	9.86763
So is the ſide BC 22 chains - -	1.34242
	11.21005
	1.21378
To the ſine angle D 97° 30′ - -	9.99627

To find the ſide DC.

As the ſ. an. C 47° 30′	9.86763		180°	
Is to the ſide BD 16c. 36l.	1.21378	Supplement of angle D	82	30
So is the ſ. an. B 35°	9.75859	The angle D	97	30
		The angle C	47	30
	10.97237	Sum of angle D & C	145	
	9.86763		180	
		Subtract	145	
To the ſide DC 12c. 72l.	1.10474	The angle B	35	

Here it may be proper to obſerve, that if the given angle be obtuſe, the angle ſought will be acute; but when the given angle is acute, and oppoſite to a leſſer given ſide, then the required angle is doubtful whether acute or obtuſe; it ought therefore to be determined before the operation; for it is plain the above proportion produces 82° 30′ for the required angle; but, as it is obtuſe, its ſupplement to 180 degrees muſt be taken, viz. 97° 30′.

BY GUNTER.

Extend your compaſſes from the ſide BD 16 chains 36 links, to BC 22 chains, on the line of numbers; that extent will reach from angle C 47° 30′, to the ſupplement of angle D 82° 30′, on the line of ſines.

2dly. The extent from angle C 47° 30′, to angle B 35°, on the line of ſines; that extent will reach from the ſide BD 16 chains 36 links, to the ſide CD 12 chains 72 links, on the line of numbers.

AXIOM III.

In all plane triangles, as the ſum of the ſides is to the difference of the ſides, ſo is the tangent of half the ſum of the oppoſite angles, to the tangent of half the difference; half that difference added to half the ſum, gives the greater angle; and taken from half the ſum, gives the leſſer angle.

PROBLEM VII.

CASES IV and V.

Two ſides and their contained angle given to find either of the other angles and third ſide.

The line BD 16 chains 36 links, and DC 12 chains 72 links, and the angle at D 97° 30′, given to find the angle at B or C, and the ſide BC. See fig. 8, plate 2.

CONSTRUCTION.

Draw the line BD equal 16 chains 36 links, and at the point D make an angle of 97° 30′; then draw the line DC equal 12 chains 72 links, and join BC, and it is done.

BY CALCULATION.

Sides	BD	16	36	BD	16	36	180°		
	CB	12	72	CD	12	72	97	30	angle D
Sum		29	08	diff.	3	64	82	30	ſ. of the 2 ang. B & C
							41	15	half ſum do.

The proportion by Axiom III will be to find the angles B and C.

As the ſum of the ſides BD & CB 29 c. 81.	1.46350
Is to their difference 3 c. 64 l. - -	0.56110
So is the tangent of ½ the ſum of the angles C and B 41° 15′ - - - - -	9.94299
	10.50409
	1.46350
To the tan. of ½ the dif. of ang. B & C 6° 15′	9.04059

To ½ the ſum of the angles C and B -	41°	15′
Add ½ the difference of the angles C and B	6	15
Gives the angle C - - - - - - - -	47	30
Subtracted gives the angle B - - -	35	

To find the ſide BC.

As the ſine angle B 35° - - - -	9.75859
Is to the ſide CD 12 chains 72 links	1.10474
So is the ſine angle D 97° 30′ - - -	9.99627
	11.10101
	9.75859
To the ſide BC 22 chains - - -	1.34242

BY GUNTER.

Extend your compaſſes from 29 chains 36 links to 3 chains 64 links, on the line of numbers; that extent will reach from 41° 15′ to 6° 15′, on the line of ſines.

2dly. The extent from angle C 37° 30′ to 82° 30′ (the ſupplement of angle D), on the line of ſines; that extent will reach from the ſide BD 16 chains 36 links to BC 22 chains, on the line of numbers.

AXIOM IV.

As the baſe is to the ſum of the ſides, ſo is the difference of the ſides to the difference of the ſegment of the baſe; half that difference added to half the baſe gives the greater ſegment, and taken from half the baſe gives the leſſer ſegment.

PROBLEM VIII.

The three ſides of a triangle given to find the angles.

The ſide BC 22 chains, BD 16 chains 36 links, and CD 12 chains 72 links, given to find the angles BDC, BCD, and CBD. See fig. 9, plate 2.

CONSTRUCTION.

Draw the line BC equal to 22 chains; take alſo 16 chains 36 links in your dividers, and ſetting one foot thereof in the point B, and deſcribe an arch. Take 12 chains 72 links in your dividers, and ſetting one foot in the point C, with the other deſcribe an arch that ſhall interſect the former in the point D; join BD and CD together, and it is done.

BY CALCULATION.

The ſide BD 16 36
The ſide DC 12 72

The ſum 29 08 of the two ſhorteſt ſides

Difference 3 64 of the two ſhorteſt ſides

As the ſide BC 22 ch.	1.34242	11	the ½ of the greater ſide
Is to the ſ. of the ſides		2 40	½ dif. of the ſegment
BD & DC 29c. 8l.	1.46350	——	
So is the dif. of the ſides		13 40	the greater ſegment
BD & DC 3 c. 64 l.	0.56110	——	
	——	8 60	leſſer ſegment
	2.02460	——	
	1.34242		
	——		
Dif. of the ſeg. of the			
greater ſide 4c. 81 l.	0.68218		
	——		

To find the angle BDA.

As the ſide BD 16c. 36l.	1.21378	90°
Is to radius - - -	10.00000	55 angle BDA
So is the greater ſeg- ment 13 c. 40 l.	1.12710	35 leaves angle B
		90
		42 30
	11.12710	47 30 leaves angle C
	1.21378	35 co-angle BDA
		47 30 co-angle ADC
To ſ. ang. BDA 55°	9.91332	82 30 ſum

To find the angle ADC.

As the ſide DC 12 c. 72 l.	1.10474		180°
Is to radius - - - - -	10.00000		82 30
So is the leſſer ſeg. 8 c. 60 l.	0.93450	angle BDC	97 30
	10.93450		
	1.10474		
To the ſ. of the ang. ADC 42°30′	9.82976		

BY GUNTER.

Extend your compaſſes from 22 chains to 29 chains 8 links; that extent will reach from 3 chains 64 links to 4 chains 81 links, on the line of numbers.

2*dly*. Extend from 16 chains 36 links to 12 chains 72 links, on the line of numbers; that extent will reach from radius to the angle BDA 55°, on the line of ſines.

3*dly*. The extent 12 chains 72 links to 8 chains 60 links, on the line of numbers; that extent will reach from radius to the angle ADC, on the line of ſines,

TO

MEASURE

INACCESSIBLE HEIGHTS and DISTANCES.

PROBLEM I.

To find the perpendicular height of the tower BC.

TAKE the angle of altitude at A = 53 degrees; then meaſure the diſtance from A to B, at the foot of the tower, 2 chains 46 links. Fig. 10, plate 2.

As the ſine angle C 37° - - - -	9.77946	90°
Is to the ſide AB 2 chains 46 links	0.39093	53 angle A
So is the ſine angle A 53° - - -	9.90235	—
	———	37 angle C
	10.29328	—
	9.77946	
	———	
To the height of the tower BC 3 c. 26 l.	0.51382	
	———	

Otherwiſe.

As radius - - - - - - - - -	10.00000	
Is to the ſide AB 2 chains 46 links	0.39093	
So is tangent angle A 53° - - - -	10.12289	
	10.51382	
	10.00000	
To the height of the tower BC 3 c. 26 l.	0.51382	ſame as before

PROBLEM II.

To find the perpendicular height of the tower BC.

On the top of a hill ABD, at one ſtation, from the point A take angle DAB 48° 30′; then meaſure the line AB to the bottom of the tower 2 chains 70 links; return back to A, and take the angle DAC 67 degrees, the height BC is required. Fig. 11, plate 2.

CONSTRUCTION.

Make the angle DAB 48° 30′, and lay 2 chains 70 links from A to B; from B let fall the perpendicular BD, and that will be the height of the hill; produce the line BD upwards, again at A make the angle DAC 67°, draw a line from A, to cut the perpendicular in the point C, the line CB is the height of the tower.

BY CALCULATION.

As the ſine angle C 23° - - - -	9.59188	90°
Is to the ſide AB 2 c. 70 l. - - -	0.43168	67 ang. DA
So is the ſine angle ACB 18° 30′	9.50145	—
	———	23 ang. AC
	9.93313	—
	9.59188	76 ang. DAC
	———	48 30 an. DAB
To the height of the tower BC 2 c. 19 l.	0.34125	———
	———	18 30 an. ACB

To find the height of the hill BD.

As radius - - - - - - - - - -	10.00000
Is to the ſide AB 2 chains 70 links	0.43168
So is the angle DAB 48° 36′ - - -	9.87448
	———
	10.30616
	10.00000
	———
To the height of the hill BD 2 c. 21.	0.30616

PROBLEM III.

To find the perpendicular height of the tower DC, *by two ſtations, it being inacceſſible by means of a river, and cannot be approached nearer than* B.

At B take an angle of altitude to C 55°, meaſure any convenient diſtance backwards to A, viz. 1 chain 70 links, then take another angle from A to C 37°; the height of the tower DC is required. Fig. 12, plate 2.

CONSTRUCTION.

Draw the line AB 1 chain 70 links, at B make an angle of 55 degrees, and from A make your ſecond angle 37 degrees; from C the point of interſection of the line, which forms theſe angles, let fall a perpendicular CD, and that will be the height of the tower CD.

BY CALCULATION.

To find the ſide BC.

As the ſine angle ACB 10° - - -	9.48998
Is to the ſide AB 1 chain 70 links	0.25527
So is the ſine angle CAB 37° - -	9.77946
	10.03473
	9.48998
To the ſide BC 3 chains 50 links	0.54475

To find DC.

As radius - - - - - - - - - -	10.00000
Is to the ſide BC 3 chains 50 links	0.55475
So is the ſine angle CBD 55° - - -	9.91336
	10.46811
	10.00000
To the height of the tower DC 2 c. 93 l.	0.46811

To find the breadth of the river BD.

As radius - - - - - - - - - -	10.00000
Is to the ſide BC 3 links 50 chains	0.55475
So is the ſine angle BCD 35° - -	9.75859
	10.31334
	10.00000
To the breadth of the river BD 2 c. 5 l.	0.31334

PROBLEM IV.

To find the perpendicular altitude of the tower DC *on the hill* DE.

From any part of the plane where the foot of the tower can be ſeen, ſuppoſe the firſt ſtation at A, take the angle DAB 21°, and the angle CAB

35°, then meaſure to the ſecond ſtation B 2 chains 15 links; and take the angle CBE 48° 30′, the height DC is required. Fig 13, plate 2.

CONSTRUCTION.

Draw the line AB 2 chains 15 links, at A ſet off the ſecond CAB 35°, and at B the third angle CBE 48° 30′; from the interſection of the lines in the point C let fall the perpendicular CE, from A ſet off the firſt angle DAB 21°, and the line ormed by it will interſect the perpendicular in e point D; DE ſhews the height of the hill, and C he height of the tower.

BY CALCULATION.

To find BC.

As the ſine angle ACB 13° 30′	9.36818	48° 30′ ang. CBE
Is to the ſide AB 2 c. 15 l.	0.33244	35 ang. CAB
So is the angle CAB 35° -	9.75859	
		13 30 ang. ACB
	10.09103	
	9.36818	
To the ſide BC 5 c. 28 l.	0.72285	

To find the ſide CE.

As radius - - - - - - - - -	10.00000
Is to the ſide BC 5 chains 28 links	0.72285
So is the ſine angle CBE 48° 30′	9.87446
	10.59731
	10.00000
To the ſide CE 3 chains 96 links	0.59731

To find the ſide BE.

As radius - - - - - - - - -	10.00000
Is to the ſide BC 5 chains 28 links	0.72285
So is the ſine angle BCE 41° 30′ - -	9.82126
	10.54411
	10.00000
To the ſide BE 3 chains 50 links	0.54411

AB 2 chains 15 links + BE 3 chains 50 links = AE 5 chains 65 links.

To find lhe height of the hill DE.

As the ſine angle ADE 69° - - -	9.97015
Is to the ſide AE 5 chains 65 links	0.75205
So is the ſine angle DAE 21° - -	9.55433
	10.30638
	9.97015
To the height of the hill DE 2 c. 16 l.	0.33623

CE 3 chains 96 links — DE 2 chains 16 links = DC 1 chain 80 links, the height of the tower.

PROBLEM V.

To find the height of a tree DC, *on the top of a hill* DE, *ſtanding obliquely by two ſtations.*

Make a ſtation at B, from whence take the angle to the foot of the tree EBD 36° 30′, and another angle to the top EBC 44° 30′. Meaſure any convenient diſtance backwards to A 2 chains 70 links; take the angle EAD 24° 30′ to the foot of the tree, then take the angle EAC 32° to the top; the height of the tree is required, Fig. 14, plate 2.

CONSTRUCTION.

Draw the line AB = 2 chains 70 links, at B make an angle = 36° 30′; then at A make an angle = 24° 30′ and this will interſect the other in the point D; let fall the perpendicular DE, and that will be the height of the hill; make another angle at B = 44° 30′, and at A make an angle = 32°, this will interſect the former in the point C; draw a line from D to C, and that will be the height of the tree required.

BY CALCULATION.

To find the ſide BC.

As ſine angle ACB 12° 30′	9.33534	44° 30′ ang. EBC
Is to the ſide AB 2 c. 70 l.	0.43136	32 00 ang EAC
So is ſine angle EAC 32°	9.72421	———
	———	12 30 ang. ACB
	10.15557	———
	9.33534	
To the ſide BC 6 c. 61 l.	0.82023	

To find the ſide BD.

As the ſine angle ADB 12°	9.31788	36° 30′ ang. EBD
Is to the ſide AB 2 c. 70 l.	0.43136	24 30 ang. EAD
So is the ſine ang. DAB 24° 30′	9.61773	———
	———	12 00 ang. ADB
	10,04909	———
	9.31788	
To the ſide BD 5 c. 39 l.	0.73121	

44° 30′ angle EBC
36 30 angle EBD

8 00 angle CBD — 6 61 ſide BC
5 39 ſide BD

180
8 angle CBD — 12 00 ſum

172 the ſ. of the ang. BDC & BCD — 1 22 differ.

86 half ſum do.

As the ſum BC + BD 12 - - - -	1.07918
Is to the difference BC — BD 1 c. 22 l.	0.08636
So is tangent ½ BDC + BCD 86°	11.15536
	11.24172
	1.07918
To the tangent ½ BDC — BCD 55° 29′	10.16254

86° + 55° 29′ = 141° 29′ angle BDC.
86 — 55 29 = 30 31 angle BCD.

To find DC, *the height of the tree.*

As ſine angle BCD 30° 31′ - - -	9.71829
Is to the ſide BD 5 chains 39 links	0.73121
So is the ſine angle CBD 8° - - -	9.14356
	9.87477
	9.71829
To DC the height of the hill 1 c. 43 l.	0.15648

To find the height of the hill DE.

As radius - - - - - - - - - -	10.00000
Is to the ſide BD 5 chains 39 links	0.73121
So is the ſine angle DBE 36° 30′	9.77439
	10.50560
	10.00000
To the height of the hill 3 c. 20 l.	0.50560

PROBLEM VI.

Let two houſes at A and B, on one ſide of a river, whoſe diſtance, as under, is 4 chains, there is another houſe at C, on the other ſide of the river, that makes an angle at A, with the line AB of 70 degrees, and another at B, with the line BA of 55 degrees; required the diſtance of the houſe at C, from AB and BC. Fig. 15, plate 2.

To find the ſide BC.

As ſine angle ACB 55° - - - -	9.91336
Is to the ſide AB 4 chains - - - -	0.60206
So is ſine angle BAC 70° - - - -	9.97299
	10.57505
	9.91336
To the diſtance BC 4 chains 58 links	0.66169

To find the ſide AC.

As ſine angle ACB 55° - - - -	9.91336
Is to the ſide AB 4 chains - - - -	0.60206
So is ſine angle ABC 55° - - - - -	9.91336
	10.97542
	9.91336
To the diſtance AC 4 chains - - -	0.60206

PROBLEM VII.

Let B and C be two trees, whoſe direct diſtance aſunder BC is inacceſſible; however, it is known that the tree at A is 5 chains from B, and 3 chains 50 links from C, and the angle BAC is found to be 65 degrees; what is the diſtance BC between the two trees? Fig. 16, plate. 2.

5	the ſide AB	180	
3 50	ſide AC	65	the angle BAC
8 50	ſum	151	ſ. of ang. ABC & BCA
1 50	difference	57 30½	do.

As the ſum of the ſides AB + AC 8 c. 50 l.	0.92942
Is to the difference AB—AC 1 c. 50 l.	0.17609
So is tangent ½ ABC + BCA 57° 30′	10.19581
	10.37190
	0.92942
To tangent of ½ ABC—BCA 15° 29′	9.44248

57° 30′ + 15° 29′ = 72° 59′ the angle ACB
57 30 — 15 29 = 42 01 the angle ABC

To find the diſtance BC.

As ſine angle ACB 72° 39′ . . .	9.98060
Is to the ſide AB 5 chains	0.69897
So is ſine angle BAC 65° . . .	9.95728
	10.65625
	9.98060
To the diſtance BC 4 chains 74 links	0.67565

PROBLEM VIII.

Let D and C be two trees in a bog, to which you can have no nearer acceſs than at A and B; at A take the angle DAB 110°, and the angle CAB 43° 30′; then meaſure the diſtance from

A to B 2 chains; at B take the angle CBA 120°, and the angle DBA 50°; the diſtance between the two trees DC is required. Fig. 17, plate 2.

110°	angle DAB	120°	angle ABC
50	angle DBA	43 30	angle BAC
160	ſ. of DAB + DBA	163 30	ſ. of ABC + BAC
180		180	
160		163 30	
20	angle ADB	16 30	angle ACB

To find the ſide DB.

As ſine angle ADB 120°	9.53405
Is to the ſide AB 2 chains . . .	0.30103
So is ſine angle DAB 110°	9.97567
	10.27670
	9.53405
To the ſide DB 5 chains 53 links	0.74265

To find the ſide BC.

As ſine angle ACB 16° 30′ . . . 9.45334
Is to the ſide AB 2 chains 0.30103
So is the ſine angle CAB 43° 30′ . . 9.83781

10.13884
9.45334

To ſide BC 4 chains 84 links . . . 0.68550

120° angle ABC	5 53 ſide DB
50 angle ABD	4 84 ſide BC
70 angle DBC	10 37 ſum
180	0 69 difference
70 DBC	
110 ſum of BCD and BDC	
55 half ſum do.	

As BD + BC 10 chains 37 links . . 2.01157
Is to BD—BC 69 links . . . , . 0.83885
So is tangent of half DCB + CDB 55° 10.15477

10.99362
2.01157

To tangent half DCB—CDB 5° 29′ 8.98205

55° + 5° 29′ = 60° 29′ angle DCB

55 — 5 29 = 49 31 angle CDB

To find the diſtance DC

As ſine angle CDB 49° 31′ . . .	9.88115
Is to the ſide BC 4 chains 84 links	0.68550
So is ſine angle DBC 70°	9.97299
	10.65849
	9.88115
To diſtance of the two trees DC 5 c. 99 l.	0.77734

PROBLEM IX.

A gentleman having a triangular garden, the length of the ſides is as follows; AB 2 chains 40 links, AC 2 chains 30 links, BC 2 chains; he wiſhes to have a dial placed in the middle at E; that the diſtance from A, B and C may be equal; required by what angle the place of it may be found, Fig. 18, plate 2.

As the ſide AB 2 chains 40 links	0.38021
Is to AC+BC 4 chains 30 links	0.63347
So is AC—BC 30 links	0.47712
	1.11059
. . . .	0.38021
To AD—DB 53 links	0.73038

½ AB 1 chain 20 links + ½ AD—AB 26 links =AD 1 chain 46 links.

To find CD.

Square AC = 5.2900 — ſquare AD = 2.1316 = 3.1584, take the ſquare root of 3.1584 = 1 chain 77 links CD.

To find the diameter of the circle.

As CD 1 chain 77 links	0.24797
Is to AC 2 chains 30 links	0.36173
So is CB 2 chains	0.30103
	0.66276
	0.24797
To the diameter 2 chains 60 links	0.41479

The half of which, viz. 1 chain 30 links is the ſemidiameter, or the diſtance of the dial from AE, CE, and BE.

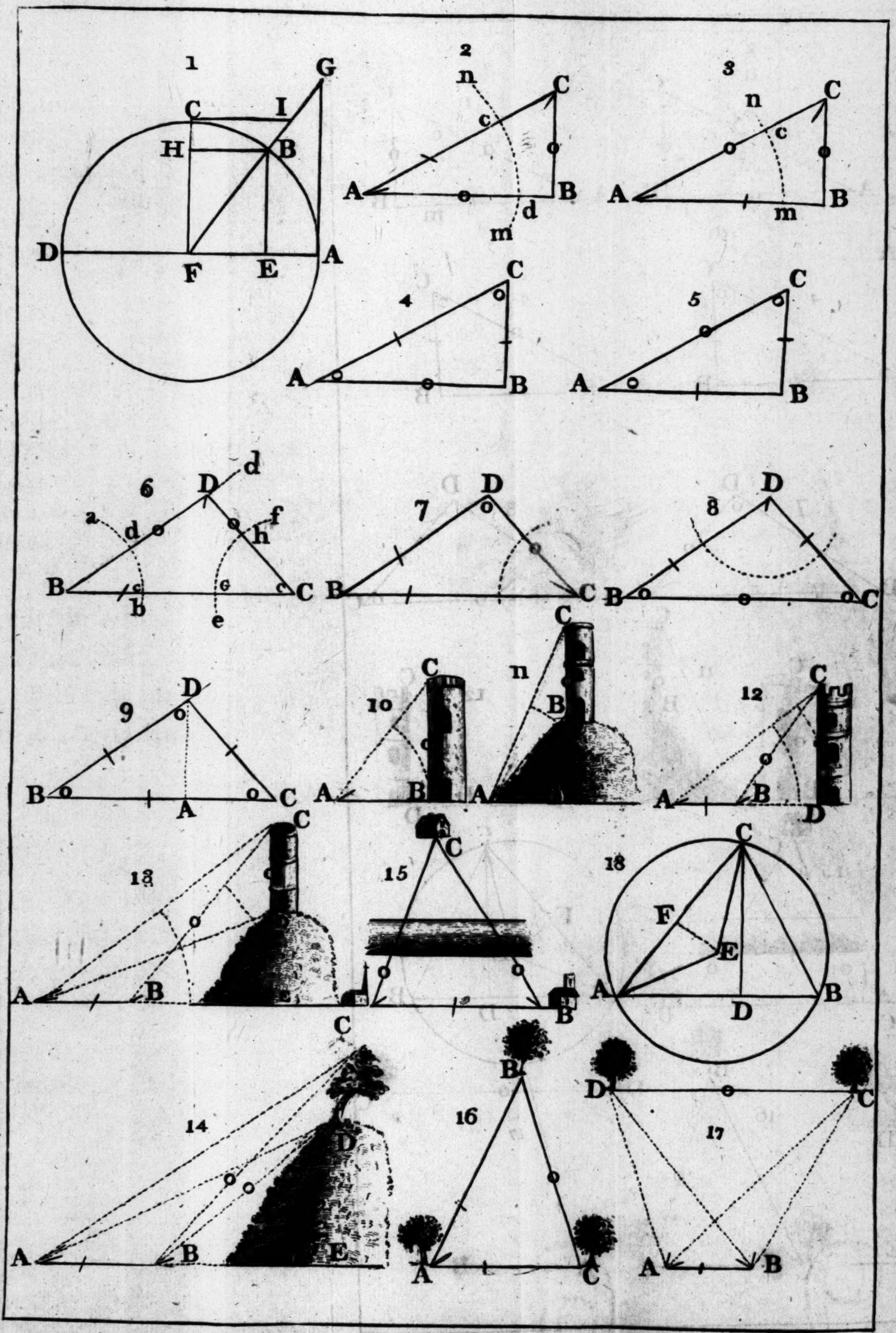
From the center E let fall a perpendicular upon any of the ſides, as EF; wherefore AE=CF=½ AC 1 chain 15 links.

To find the angle FAE.

As AF 1 chain 15 links	0.06070
Is to radius	10.00000
So is AE 1 chain 30 links	0.11394
	10.11394
	0.06070
To ſecant angle EAF 27° 48′	10.05324

At A make an angle=27° 48′ with the line AC, and meaſure 1 chain 30 links, on the line of directions; this will give of the dial in the center of a circle that will paſs through A, B, and C at equal diſtances.

Plate 2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PART II.

CHAP. I.

Deſcribes the Chain, Croſs Staff, and Offset Staff, with uſeful directions and cautions to practitioners in the field.

SECTION I.

OF THE CHAIN.

THE Chain I ſhall here take notice of is that invented by Mr. Gunter, and commonly called Gunter's Chain. It is in length 4 poles, or 22 yards, and divided into 100 equal parts, called links; each link being 7.92 inches: at each tenth link is fixed a piece of braſs, with notches, or points; that at 10 links having one notch, or point, that at 20 links two points, at 30 three, at 40 four, at 50, or middle, is a large round plain one, at 60 the ſame as forty, at 70 the ſame as 30, &c. By this mean it is eaſy to count the links from each end of the chain. The firſt link at each end is uſually made into a large ring, or bow, for the eaſe of holding it in the hand.

OF THE CROSS STAFF.

The Croſs Staff is about 5 feet 6 inches long, made ſharp at one end, to enter the ground readily; and a ſmall round braſs plate, or wood, about 6 inches diameter, fixed on the top thereof with a ſcrew. If the head of your croſs ſtaff be braſs, let there be put thereon four ſmall ſtuds at the end of the diameters; ſo that if two lines were drawn from the oppoſite ſtud, or points, they would paſs through the center of the plate, and croſs each other at right angles. But if the head thereof be wood, two ſaw nicks a quarter of an inch deep in the board, at right angles, will anſwer the ſame purpoſe

The uſe of the above ſtaff is as follows: When chaining in the field, if you have occaſion to raiſe a perpendicular to any aſſigned point or corner, your eye can inform you if you are near the place it ſhould be; then ſtick down your croſs ſtaff perpendicularly, that upright, and fixing one of the lines that are thereon directly over your chain, and parallel thereto as it lies on the ground;

apply your eye to the end of the other line (on the ſtaff head), and looking along the ſame, if you perceive the aſſigned point in a direct line with that which you look along, and you have found the place; but if the mark lies to the left, or to the right, you muſt remove your ſtaff, and place it accordingly.

OF THE OFFSET STAFF.

The Offset Staff is beſt made of deal, or ſome ſuch light wood, and ſhod at one end with iron, and made ſhrap or pointed a little, to ſtick into the ground when there is occaſion; at the other end may be a ſmall notch, it being of uſe for putting the end of the chain through hedges, &c. This ſtaff muſt be exactly 10 links in length, or 6 feet 6 inches, and divided into ten equal parts, or links; the firſt link may be divided into ten equal parts or decimals of a link, which may be uſeful in ſome nice caſes

SECTION II.

OF MEASURE.

I ſhall in this place give ſome neceſſary directions how to uſe the chains in meaſuring lines.

Let the chain leader be provided with ten ſmall arrows, about 12 inches long; or ten ſmall wire pins, made ſharp at one end, to enter the ground readily, and a nooſe at the other end, to which a piece of red cloth ſhould be faſtened, that it may thereby be more eaſily found in graſs, &c. Let him that follows the chain ſee that the leader always puts down his arrow perpendicular, and in a direct line with the object he is going to, or bound for, which he may do by making him, at the end of every chain, before he puts down the arrow, cover or intercept the mark he is going to; for if he ſwerves from a right line, it will make the diſtance longer than it really is; a right line being the ſhorteſt diſtance between two points. The chain leader and follower cannot be too careful in reckoning their arrows to each other at the end of every line, and every change; that is to ſay, the meaſurer, or chain follower, muſt count ten arrows to the leader at the end of every change; but if any ſhould be miſſing, it is impoſſible to know who loſt it, and therefore they muſt not only go back and find the loſt arrow, or arrows, but alſo meaſure the ſame line over again. But, to prevent all ſuch miſtakes, let him that leads the chain take all the arrows in his left hand, and the chain upon the two firſt fingers of his right hand; then let him take one of the arrows into his right hand with the chain, and proceed the to place direĉted; and at the end of the chain let him ſtick the arrow down which he held in his right hand, and take another out of his left hand, and thus proceed until all the arrows are done; then the meaſurer, or chain follower, muſt carefully count the arrows to the leader, and if the line be any longer, proceed as above direĉted, always remembering the changes you have in each line, and at every change count the arrows, as above direĉted. If it be roads you meaſure, 80 ſtatute chains make one mile.

SECTION III.

Directions to chain followers and young practitioners in the field.

Upon the chain follower depends all the care of meaſuring, remarking, and noting down dimenſions, &c.; and, therefore, it abſolutely behoves every one that would be a ſurveyor, to be not only particularly careful in his entries, and correĉt in his dimenſions, but alſo very circumſpeĉt in his obſervations, with regard to the ſituation of buildings, timber, water ponds, brooks, and dingles, whereby he may draw a perfeĉt plan from the field notes, if required, when in his chamber When he enters the field or incloſure that he intends to meaſure, let him carefully obſerve thoſe hedges or fences that are next, if they are ſtraight, curved, or circular, and always remembering to leave a mark at the beginning, in the fence or hedge, that will appear, if required, at a ſufficient diſtance. Direct your chain leader to obſerve the motion of your left hand, which is to guide him in a right line to the place bound for, by moving to the right or left hand, according as he is wide of the mark he is going to; and when you have got him in a right line, that is, directly between you and the mark, ſtoop down inſtantly, and take up the arrow that your foreman, or leader, put down, with the ſame hand that you hold the chain in, laying hold of the arrow cloſe to the ground; and let the chain leader ſtick down an arrow at the ſame time that you take up yours, with the chain at full ſtretch. Obſerve, when you direct your leader, or chainman, to keep in a right line with your mark, to place your eye and chain hand directly over the arrow that ſticks in the ground; and as ſoon as he has put his arrow down, let him fix his eye upon the mark he is going to as he moves forward, which will ſave you a vaſt deal of trouble in keeping him ſtraight; for it is not very poſſible for him to ſwerve from a right line, provided he keeps the mark in view as he moves forward. In hilly ground, if the meaſurer loſes ſight of the mark he is going to, he muſt ſtand over his arrow, and the leader muſt turn and move himſelf till he gets the meaſurer between him and the mark departed from. Never attempt to draw a balancing line, upon any conſideration whatever; for it is attended with notorious errors, notwithſtanding ſuch random work, for ages paſt, has been too much practiſed, which affords us one reaſon for the general diſcord amongſt old practitioners; for a balancing line is either real or imaginary; viz. real in the chamber, and imaginary in the field: in each caſe the line is inſtituted by the practitioner to avoid trouble, and conſequently accuracy alſo.

In the boundaries of the eſtates you are to meaſure and map, obſerve the hedges and ditches, that is, to whom they belong; and here note, that if the ditch is between the field you muſt meaſure and the hedge, that ditch belongs to the neighbouring gentleman's land, and therefore you muſt allow 4 feet, or 6 links, from the quick roots in the hedge, that is to ſay, you muſt not meaſure within 6 links of the hedge; but if the hedge is between the field you are meaſuring and the ditch, then it muſt be meaſured therewith. The allowances for ditches differ in many countries, viz. ſome allow but 3, ſome 4, ſome 5, and ſome 6 feet: however, I think 4 feet is ſufficient. And as for the hedges and ditches within the eſtates, meaſure the ditch to one field, and the hedge to the other, when you are to map. Let all the offsets you take up be as near the fence and as ſmall or narrow as poſſible, and when you begin to take up an offset, remember always to look along the fence, or hedge, that it lies up to, and remark whereabouts in the fence your firſt perpendicular ſhould riſe to; and when you have taken the ſame, ſtand at the end thereof, and look again along the fence where the ſecond ſhould riſe to; and in this manner you muſt do at the end of every one that you erect: be careful that you take your perpendiculars ſo, that if a right line was drawn from the end of any one to the next, that line would neither include the neighbour's ground, nor exclude any part of that you are about to meaſure.

SECTION IV.

OF THE FIELD BOOK, AND DIRECTIONS IN THE FIELDS.

Having particularly deſcribed the Chain, Croſs Staff, Offset Staff, and Arrows, I propoſe here to ſhew how to prepare the Field Book, and alſo the method of entering the field notes, or dimenſions, with all imaginable exactneſs, by the pen, and not with black lead pencils, leſt the ſame ſhould be defaced by the rubbing of the leaves, which often happens.

Let your field book reſemble that of a common pocket book, with a claſp on one ſide of the cover; which, when you have made an entry, being placed between the leaves, the book may be returned to the pocket. Each page therein muſt be divided into two equal parts, or columns, by a black line; and if you are to map the field which you are about to meaſure, let the firſt column in each page have wrote on the top thereof the field's name, under which the dimenſions of the ſame muſt be inſerted, as hereafter: the right hand column muſt be reſerved to contain neceſſary remarks, which frequently occur, ſuch as timber, ponds, pits, plantations, buildings, gates, and ſtiles; together with the bearings of remote objects remarkable, as ſteeples and wind-mills, towns, cities, &c. which being properly repreſented in a map, that is if room permits, will be an additional embelliſhment thereto. But if the land you are about to meaſure is not to be mapped, then there will be no neceſſity for appropriating the right hand column to any ſuch remarks.

OBSERVATIONS.

Remember to expreſs therein the owner's name, &c. of the eſtate that you are to ſurvey, thus:

Dimenſions of an eſtate, or manor, in the pariſh of ——, in the county of ——, belonging to E—— S——, Eſq. and now held by ———— [Here mention the tenant, or tenants names, if more than one; and, where you begin, enter the tenant's name above your dimenſions; do ſo in each diſtinct tenement.]

The reader will find the form of this book claims the preference to all others uſed in this ſcience; it is not only plain and conciſe, but abſolutely complete alſo. However, I am not inſenſible, that there are ſcarcely three ſurveyors in the kingdom that have exactly the ſame method of entering their field notes.

THE FORM OF FIELD BOOK.

Thomas Jones holding
horſe paſture.

North offset LH.

At 0 ——— 0
3 46 ——— 0 85
4 21 ——— 1 38
5 42 ——— 0 00
6 00 ——— 2 41
6 89 ——— 1 54

Weſt offset LH.

Remarks.

A pond of water on 2 chains right hand.

36 timber trees on north ſide horſe paſture, equal diſtance.

Thus expreſſed, 26 T. T. eq. D.

If you would diſtinguiſh the timber, you may obſerve the following characters,

a. aſh, A. large aſh.
o. ſmall oak, O large do.
P. poplar.

A few days practice in the fields will render thoſe remarks both familiar and eaſy.

The Notes in the Field Book explained.

At 0, that is, at no length, is the firſt perpendicular, provided you do not begin in the corner of the field; otherwiſe it would be, at 0 it is 0, that is to ſay, at no length, to wit, the beginning it is no breadth. But herein carefully obſerve, that when you come to the hedge where the mark is fixed to which you meaſured, if the ditch be in the field, ſuffer your chain leader to go no farther than the nearer ſide of the ditch, and allow four feet, or ſix links, for a ditch, the ditch being the property of the next field: and if it ſhould happen, as it often does, that there is not quite a chain between the laſt arrow and the hedge or ditch you are to meaſure to, let the chain leader fix the chain end at the ditch ſide, and hold it there till the meaſurer comes to the laſt arrow, and laying hold of the chain thereat, take it up, and count the links by the help of the braſs marks before mentioned, which muſt be inſerted with the chains that the ſaid lines meaſure to: as, for inſtance, ſuppoſe you are ſtanding at the laſt arrow, and diſcover it to be one, two, or three tens, and ſome odd links paſt, or more than fifty, which muſt be reckoned to fifty, and the ſum will make 60, 70, or 80, together with the odd links. The like is to be obſerved in all other examples of this kind in chaining. One day's practice in the fields with the chain will render you quite perfect in counting the odd or ſurplus links. As you are chaining your baſe line, and a turn or bend in the hedges appears, which you find directly oppoſite to 3 chains 46 links, you then meaſure with your offset ſtaff, being 10 links in length (the chain lying on the ground at full length), the diſtance between 46 links and the corner, or bend, being juſt 85 links, which you muſt thus enter in figures: at 3.46———85; and then proceed with your main line; and oppoſite 4 chains 21 links, another turn appears in the hedge, which you muſt alſo meaſure as above directed, and enter it likewiſe thus: at 4.21———1.38; proceed with your main line, and oppoſite 5 chains 42 links is 00, which ſignifies there is no perpendicular there, which enter thus: at 5.42———00; proceed again with your main line, and oppoſite 6 chains is another turn, which meaſure as before, and enter thus: 6.00———2.41. When ſtanding at this laſt corner, you obſerve the hedge to be ſtraight to the end, and therefore there will be no neceſſity for any more perpendiculars till you finiſh the line, and then you take up the laſt, viz. at 6 chains 89 links is 1.54, which enter thus: 6.89———1.54. The word *at* is always underſtood, but never expreſſed, for brevity's ſake.

More directions to young ſurveyors in the field.

In meaſuring by the chain only, or taking exactly the dimenſions of any field, or incloſed piece of ground, it is moſt methodical to begin at ſome remarkable place, viz. houſe, gate, ſtyle, tree, &c. and for want of ſuch, fix a mark at your ſtarting place, and from thence proceed orderly, according to the ſituation of the field, viz. if a four-ſided irregular field, firſt ſtraighten the boundaries thereof, by taking up the offsets; and the body of the field you may take in a trapezium, or rectangle, which ever ſeems convenient. It is not material in meaſuring with the chain, whether you go to the right hand or left, that is to ſay, with or againſt the ſun.

It will not be amiſs for the young ſurveyor, ere he is perfect in field practice, at his entrance into the field, to obſerve, if poſſible, its form, and with a pen, or pencil, draw, at adventure, a figure that may ſomewhat reſemble the ſame, which will enable him to plan, when in his chamber, the dimenſions thereof with leſs heſitation: but where he is ready in the practical part of ſurveying, ſuch delineations will be unneceſſary.

When you are accidentally obſtructed in meaſuring any line by the interpoſition of pits, ponds, or any thing elſe, you may, at the brink of the pond, or pit, ſtretch the chain to the right or left, which ever is moſt convenient, at right angles to the line you are meaſuring; and at the end of that chain,

&c. you may proceed parallel to your firſt line, until you are paſt the pond: then one chain, &c. at right angles, on the ſide the pond lies, will bring you into a direction with your firſt line. When the field contains a greater number of ſides and angles, and being bounded one ſide by a brook, or river, your firſt care muſt be to ſtraighten the hedges, brook, or river, then meaſure the body of the field. In mapping old brooks, which generally have numberleſs turnings and curved windings, it is extremely difficult to expreſs the ſame when taken from a ſmall ſcale; notwithſtanding, you muſt, in taking the dimenſions thereof, always be very particular: however, all brooks, and whatever branches of rivers which you meet with in your ſurvey, ſhould be expreſſed, and particularly when they run into the main river, provided the eſtate your are meaſuring conjoins, or is ſituated near the ſame. If you chuſe, you may put in your map, provided the ſize of the vellum will admit thereof, all contiguous edifices, i. e. caſtles, halls, houſes, mills, churches, and objects of note; which, if well finiſhed, will be of great addition to its beauty. In meaſuring a baſe line adjoining a hedge, it ſometimes happens that you are prevented chaining ſo near the ſame as you ſhould, by the obſtructions of briars thorns, pits, buſhes, or other things intercepting; in this caſe you muſt meaſure a ſtraight line at ſome convenient diſtance, parallel (if you think proper) to the hedge, and from thence erect perpendiculars to each turning, noting the ſame down as an offset, whether on the right hand or left hand, it matters not, with its ſituation: as, ſuppoſe a north eaſt offset, left hand, with the field's name, write over it thus.

Horſe paſture.
North E. off. LH.

An Offset, and how taken, explained.

An offset is an irregular ſpace of land, intercepted between a baſe line and the ſubtending limits of an incloſure, to every corner of which perpendiculars are or ſhould be raiſed.

The ſituation of an offset, reſpects the cardinal or chief points of the compaſs, by ſome called the Mariner's Compaſs, i. e. eaſt, weſt, north, and ſouth; but when land is to be meaſured only, and not mapped, there will be no neceſſity to regard the bearing or plan thereof; and as there are numbers of country people, whoſe ambition aſpires no higher than to meaſure a field or ſo of the compaſs, which contains 32 points, with regard to navigation; but in ſurveying they are reduced to 8, namely, the 4 cardinals, or chief points, as eaſt, weſt, north, ſouth; and 4 compound, viz. north eaſt, north weſt, ſouth eaſt, ſouth weſt, which are abbreviated in the field book, and may be expreſſed by their initial letters, to wit, E. W. N. S.; NE. NW. SE. SW.

And that the young ſurveyor may not be at a loſs, when in the field, how to adjudge the bearing of each offset therein, let him call the ſide of the field next the ſun riſing eaſt, the oppoſite ſide will be weſt; and in chaining from the weſt towards the eaſt, you will have the north on the left hand, and ſouth on the right hand: but if he ſhould chain any how between the above-mentioned chief points, that is to ſay, between the north and eaſt, and an offset ſhould occur on either the right or left hand, that upon the right will will be a ſouth eaſt one; and the left hand ſide muſt be called, or entered, a north weſt offſet. When the young ſurveyor enters a field, let him obſerve with care the ſituation, with regard to the eaſt, weſt, north, or ſouth ſides thereof; and whatever lines he meaſures when ſtraightening the ſides, or otherwiſe he muſt enter the ſame as above directed; i. e. if an offset occurs to the right or left hand of the baſe line, when in chaining, the ſide that ſubtends to the north is called a north offſet; if the weſt, it is called a weſt one; if the ſouth, a ſouth one; and if ſubtended any how to the north weſt, it muſt be called, or entered, a north weſt offſet. But if, in his conjecture of the field's ſituation, he ſhould vary a point or two, it is not very material; however, he muſt be careful to correct the miſtake ere he leaves the field, or returns a map thereof, which he may perform thus; let him obſerve when the ſun is full ſouth, that is, when it is noon, or midday; and whatever line he has taken in the fields that points thereto, is a meridian line, by which the ſituation may be accurately corrected; but if any of the lines be at right angles thereto, it is then an eaſt and weſt line, by which alſo the meridian is found. It happens ſometimes in hazy weather, when the ſun does not appear, that a ſurveyor will be at a loſs to form an idea of the land's ſituation. In theſe caſes an opportunity muſt be embraced, when the ſun ſhines at noon, to obſerve what hedge or line points thereto, which, when found, will be a meridian line. Here you have no occaſion to regard the variation of the compaſs, when you have obtained the meridian line by the help of the ſun, if you cannot obtain the true ſituation by reaſon of the ſun's obſcurity, or otherwiſe, and a horizontal or direct ſun dial be erected in any part of the premiſes, the gnomon, or ſtile, thereof always, if truly erected, points to one or other of the above-mentioned chief, or cardinal, points, by which the true ſituation may be found. An offset upon an offset, is a perpendicular taken upon a perpendicular to ſome turn or bend in a hedge or brook. In mountainous or hilly grounds, meaſure the ſuperficies thereof, and return the ſame, being repreſented as ſuch in your map, and directed hereafter; but be careful not to encroach into or upon the adjacent incloſures, but fix the hill or mountain on its true foundation, which you may do by the help of plane trigonometry, by taking the altitude of the hill. If your orders be to return an account of the timber in the ſurvey, firſt plan the whole; and, if you think proper, you may take the plan into the field afterwards, and note down, with a lead pencil, not only the number of trees as they grow in the hedges reſpectively, but alſo whatever elſe is remarkable, as pits, ponds, roughs, gates, ſtiles, or any notable or remarkable thing omitted in your dimenſions; by which means you will have a perfect plan to complete a map by. When you are to ſurvey a manor or lordſhip, where there are houſes, yards, gardens, orchards, and folds, or other ſmall inclocloſures, it is beſt to begin with the large open fields; and, if you chuſe, your mean line may paſs near the ſame, by which means you may take up the ſame between two adjacent perpendiculars; for it often happens, by reaſon of dunghills, ponds, buildings, &c. you cannot conveniently come at or to them to meaſure, but when you have got the ſame between any two perpendiculars, by taking up the offſets. Having completed the dimenſions, remarks on timber, ſituation, woods, bogs, hills, rocks, fountains, moors, and marſhes, with every other material proper to be remarked or noticed, the next care will be to draw a fair map of the whole.

When any part of the eſtate you are to meaſure lies contigous or adjoining to foreſts, commons, or waſte land, you muſt allow four feet and a half, or 7 links, for all ditches adjoining thereto, and four feet between gentlemen's eſtates. All road, whether public or private, (foot paths excepted) ſhould not be meaſured upon any tenant who pays for holding by the acre: there is no gentleman would inſiſt upon payment from any tenant for land that is promiſcuouſly the property of the public. If every ſurveyor would repreſent the unreaſonablenſs of the above cuſtom to the gentlemen who employ them, the ſame would be immediately redreſſed, and that ſevere practice would be utterly aboliſhed, to the great comfort and ſatisfaction of the poor, pains-taking tenant, who perhaps labours under the heavy burden of rack-rent and a helpleſs growing family. I would not have it underſtood, that roads ſhould not be meaſured; for I would have them meaſured and mapped accurately, and returned ſuch, and not as arable land, which is too often the caſe. When the eſtate, or any part thereof, is bounded by a river or running brook, meaſure no farther upon the tenant than to the water ſide; but in your map be careful to repreſent the brook or river. When the boundaries are ſtone or brick walls, meaſure no farther than the outſide thereof. If a turnpike road ſhould paſs through any part of the eſtate, allow 30 feet for the breadth thereof; that is, meaſure within five of the road's center, unleſs the fence on either ſide proves cloſer together, and then you muſt meaſure up thereto: if moors, marſhes, bogs, heaths, ſhallows, pools of water, ſhrubs, or rocks belong to and adjoin the eſtate, meaſure what is improveable firſt; and if any of the rejected part will admit of improvements, meaſure and return it as ſuch: the remainder ſhould appear in your map as unprofitable ground. In the map it will be proper to ſhew to whom the land belongs that ſurrounds the eſtate, which muſt likewiſe be obſerved when taking up the dimenſions; but if you ſhould happen to omit ſuch neceſſary remarks in the field book, the tenant, or perſon who occupies the eſtate, can inform you by the plan where ſuch and ſuch a gentleman's land commences, and alſo how far it continues, which you may accordingly enter in your plan as effectually as if you was directed by your field notes.

CHAP. II.

Containing plain eaſy rules and directions to meaſure with the Chain Croſs Staff all manner of ſquare and triangular fields, and caſt up the ſame by the pen.

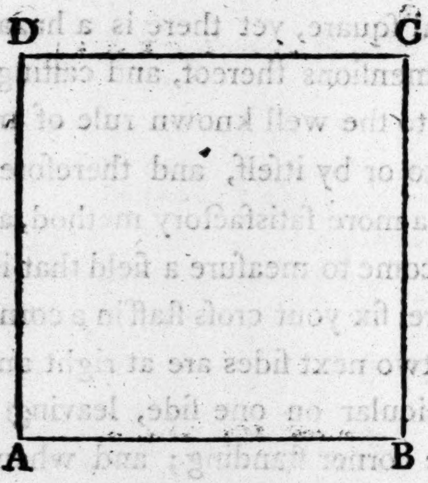
SQUARE FIELDS.

THOUGH ſuch are ſeldom met with, and if by chance one meets with an incloſure that is a geometrical ſquare, yet there is a hazard in taking the dimenſions thereof, and caſting them up according to the well known rule of multiplying the ſide into or by itſelf, and therefore I ſhall recommend a more ſatisfactory method, and that is, when you come to meaſure a field that is ſuppoſed to be ſquare, fix your croſs ſtaff in a corner thereof, and if the two next ſides are at right angles, erect a perpendicular on one ſide, leaving your croſs ſtaff in the corner ſtanding; and when you have meaſured the ſide, enter it down, and come back to your ſtaff; then meaſure the other, which, if it be ſquare, will be equal to the former; and, at the end thereof, if the third ſide be perpendicular to the baſe, or laſt meaſured ſide, meaſure its length alſo. Now, if the baſe and each of the perpendiculars be equal, the field is a true ſquare, otherwiſe not; if ſquare, you may multiply the ſide by itſelf.

PROBLEM I.

Let it be required to find the content of a ſquare piece of land.

Let the figure ABCD repreſent a ſquare piece of land; required the content thereof in ſtatute meaſure.



When the dimenſions of land (taken by a four pole chain) are caſt up, the reſult is either ſquare or half ſquare chains, but if the dimenſions were taken by a one pole chain; the reſult would be ſquare poles; and ſo of any other dimenſions. When you come into the field ABCD, make for the corner A (though any corner in the field would anſwer the ſame purpoſe), and there place your croſs ſtaff, by which the ſide AD will be found to ſtand perpendicular to AB; then meaſure the ſide AD, and you will find it contains 14 chains 20 links, which enter as below; come back to your croſs ſtaff, take it up, and meaſure the ſide AB, which you will find to be 14 chains 20 links.

Laſtly. Fix your croſs ſtaff in the corner B, and you will find that the ſide BC is likewiſe perpendicular to AB; which, being chained, will be found to agree with the former, viz. 14 chains 20 links.

DIMENSIONS.

		C. L.
At 0	————————	14 20
At 14 20	————————	14 20

In words thus expreſſed:

At the beginning, that is, at no length, it is the firſt perpendicular AD = 14 chains 20 links; and at the end of the ſide AB = 14 chains 20 links, it is the ſecond perpendicular BC =

14 chains 20 links. Now as the ſides are equal, and the angles equal alſo;—

14 20 } The ſide multiplied by itſelf
14 20 } gives the content.

28400
56800
14200

20.16400
4

.65600
40

26.24000

	A	R	P
anſwer	20	0	26

Point off the fifth figures, the remainder to the left are acres, and the right hand figures are decimal parts of an acre.

PROBLEM II.

Let it be required to find the content of a rectangular piece of land, commonly called an oblong, or long ſquare.

Suppoſe the rectangular figure ABCD repreſent a piece of land, the content is required in ſtatute meaſure.

Fields of this kind are oftener met with than the former; ſo that in meaſuring this, and all ſuch like incloſures, you muſt proceed as you were taught in the laſt problem; and if you find the ſide BC and AD to be perpendicular to the ſide AB, and both equal, you may multiply the length with the breadth, which gives the content: but to prevent any doubt of its regularity, fix your croſs ſtaff in the corner at B, perpendicular as before directed; by which you will diſcover if the ſide AB be at right angles to BC, then chain the ſide BC firſt; when done, return to the corner B, and chain AB alſo; in like manner you muſt examine if the ſide AD be likewiſe at right angles to AB, which you may know by the help of your croſs ſtaff: chain AD alſo; and having found the field rectangular, enter the dimenſions thereof thus:

	C. L.
At 0 ———————	7 44
At 16 64 ———————	7 44

16.64
7.44

6656
6656
11648

12.38016
4

1.52064
40

	A	R	P
20.82560	12	1	20¾

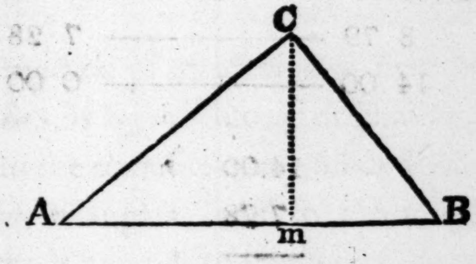
This problem is not much unlike the former, both in the dimenſions and work, and therefore it is quite unneceſſary to give any more examples.

PROBLEM III.

To find the content of any plain triangular piece of land.

The area or content of every triangle is equal to half the rectangle contained under the baſe and perpendicular of the ſame; that is, the baſe multiplied by the perpendicular, half the product is the content.

Let the triangle ABC repreſent a piece or parcel of land, the content thereof is required.



Now, in order to meaſure this triangle, begin at A, and chain towards B; when you come to m, that is, at 8 chains 79 links upon the baſe line, you will find by the croſs ſtaff that the perpendicular mC will riſe at the point m, which you muſt chain or meaſure before you proceed farther, and you will find it to be 7 chains 28 links; then return to and meaſure from the ſtaff to the end of the line, or corner B, always remembering to leave the arrows with the croſs ſtaff which belongs to the ſide or baſe AB, that is to ſay, thoſe arrows that you took up before you engaged the perpendicular; and the arrows that belong to the perpendicular return to your aſſiſtant at the end thereof. When you come back to your croſs ſtaff re-take the former arrows, and then proceed till you have chained to the end of the baſe.

Dimenſions are thus entered:

At 0 ——— 0 0
8 79 ——— 7 28
14 00 ——— 0 00

14.00
7.28
11200
2800
9800
2)1019200
5.09600
4
38400
40
15.36000

A R P
5 0 15¼

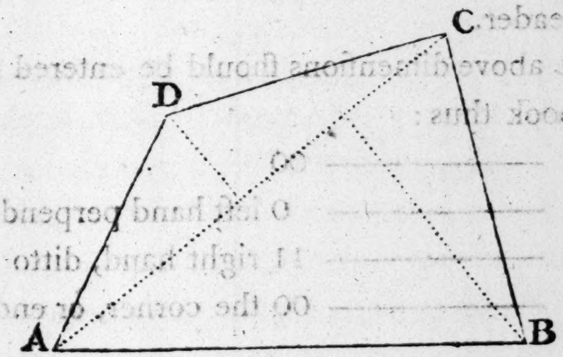
PROBLEM IV.

OF A TRAPEZIUM.

Let it be required to find the content of a field that is comprehended under four unequal ſides.

The method of meaſuring a field of four unequal ſides, is by meaſuring or chaining from one corner to the oppoſite one, which divides the field into two triangles; and in chaining, generally called the diagonal, you muſt erect perpendiculars ſeverally to the other corners of the field; ſo that as the diagonal is a baſe line common to both perpendiculars, you may add the perpendiculars together, and multiply their ſum by the diagonal; half the product is the content.

Let the trapezium ABCD repreſent a four-ſided field, the content thereof is required.



Now, to meaſure the above field, begin at the corner A, and chain to the oppoſite corner, namely, C; and when you proceed you will find the perpendicular D to riſe firſt, which meaſure, and enter as below; and where the perpendicular ariſes, meaſure it alſo, always remembering to leave the diagonal arrows with the croſs ſtaff ſtanding where you find the perpendicular to riſe, which will help you to diſcover where the laſt arrow in the diagonal or baſe line ſticks, as alſo the arrows that belong to that line, which muſt not be mixed with the perpendicular arrows, otherwiſe a miſtake may enſue; retake the diagonal arrows and croſs ſtaff; come up to the ſtanding arrow, and then proceed; in like manner you muſt find the other perpendicular at B; return and chain the line to the end or corner C, which you will find to be 18 chains 88 links; and at the end of every perpendicular return the arrows to your leader.

The above dimenſions ſhould be entered in the field book thus:

0 ———————— 00
9 24 ———————— 0 left hand perpendicular
13 92 ———————— 11 right hand, ditto
18 88 ———————— 00 the corner, or end C.

11.00 } perpendiculars
4.00 }

15.00 ſum
18.88 diagonal

120
120
120
15

2)28.320

14.160
4

640
40

	A	R	P	
25.600	14	0	25	anſwer required

CHAP. III.

Contains plain and eaſy rules to meaſure with the chain, and by the pen to caſt up the dimenſions of all manner of offsets that are bounded by right lines, though irregular hedges.

ANY field comprehended under more than four ſides, may, with great propriety, be underſtood by the term *Polygon.*

I have endeavoured to avoid, hitherto, every thing that does not immediately relate to field practice; I therefore beg leave to be excuſed in not giving particular rules concerning regular polygons, as they are called. Thoſe figures are innumerable, being formed by any number of equal chord lines conjoined in a circle. They are never met with in practical ſurveying, unleſs in ſome gentlemen's gardens, where ſurveyors are ſeldom employed; and though they are, dimenſions may be taken therein of the moſt regular or irregular figure, without reſpecting the ſame as a polygon, which are particularized by ſignificant names, according to the number of ſides that are therein: for inſtance; a regular pentagon contains five equal ſides, and as many equal angles; a hexagon contains ſix equal ſides, &c. a heptagon ſeven, an octagon eight, a nonagon nine, a decagon ten, an undecagon eleven, and a duodecagon twelve; ſo that in meaſuring any of thoſe figures with a chain, reduce the ſame into triangles and trapeziums; and whereby the area may be obtained, is ſufficient to be underſtood; and therefore it would be great prolixity to recommend rules for finding the content of all ſuch figures, which more properly belong to another branch. To meaſure an incloſure of any number of ſides more than four, whether a pentagonal, hexagonal, or other term, to wit, of five, ſix, ſeven, eight, or more unequal ſides, the ſame may be performed by diagonal and perpendicular lines, without having reſpect to the equality of the angles in the field: to effect which, you are to begin at ſome corner thereof, always remembering to leave a mark at the place of ſtarting, if it be not otherwiſe remarkable by either houſe, tree, gate, ſtile, &c. and from thence proceed to take up the ſame in triangles or trapeziums, which ever appear moſt convenient, provided the hedges be ſtraight, otherwiſe they muſt be ſtraightened by meaſuring a baſe line near the ſaid curved hedge, and erect thereon perpendicular lines to every turn, or ins and outs, in the fence or hedge contiguous thereto; but be careful to find the areas of each triangle and trapezium reſpectively by the pen, and not by ſcale and dividers; for that method is moſt certainly attended with the unavoidable errors of eſtimation.

In planning or mapping, ſome may have a deſire to take ſeverally the quantity of the interpoſing angles made by every two adjacent ſides in a field; in this caſe you are always to meaſure regularly round the field, both ſides and angles; thus if the field's ſuperficies be horizontal, you muſt place in the corner where you intend your firſt angular point to be, ſtick one of your arrows perpendicular, and from thence meaſure two chains in a right line with the mark that you intend to go firſt to by the hedge ſide; and at the end of the ſaid two chains, ſtick down another arrow; in like manner meaſure two chains in a right line with your laſt ſtation, or the hedge which you are to meaſure laſt, and there place another arrow likewiſe, which muſt be entered in your field book; then the neareſt diſtance between theſe two meaſuring arrows being meaſured exactly in chains, links, and inches, and nearer if poſſible, this laſt line is a chord line to the angle ſought, and muſt be accordingly noted down in your field book ere you proceed to meaſure the length of the next hedge: thus ſhall you proceed in meaſuring the intercepting angles, and the length of each ſide reſpectively, until you have ſurrounded and completed the field.

As ſurveying admits an unlimited variety of figures, it is therefore neceſſary to obſerve, that any multilateral figure, of what number of ſides ſoever, the ſame may be divided into a number of triangles leſs by two than there are ſides in the figure, and conſequently requires ſo many diagonals leſs by three than the number of ſides are. In meaſuring a field by diagonals, it is requiſite to chuſe the longeſt baſe line, or diagonal, for they are not only ſooneſt meaſured, but leſs liable to error; for the longer the baſe line of a triangle is, the more obtuſe the ſubtending angle will be, and leſs ſubject to miſtake; ſince the perpendicular is ſhorter, and the place it ſhould riſe much readier found; but, on the contrary, more remote that angle is which ſubtends the baſe, there is more difficulty in obtaining the identical place where the perpendicular ſhould riſe, and the leſs certainty, which every practitioner can teſtify; and if you be but one yard wide of the true place, you will certainly make the land more than it is.

It is likewiſe remarkable in practical ſurveying, that a field or parcel of land, encompaſſed by hedges, being often meaſured, will always differ ſomewhat more or leſs in the reſult.

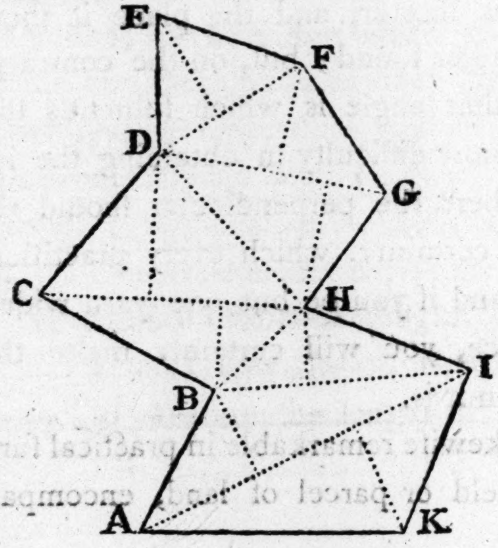
PROBLEM I.

Of irregular fields, conſiſting of any number of ſides and angles; how to meaſure and caſt up by the pen any cloſe, or field, whoſe ſides and angles are both many and irregular.

RULE.

Reduce the field to trapeziums and triangles, and meaſure each ſeparately; caſt up the ſeveral dimenſions thereof, and collect the reſpective areas, the ſum of which is the ſuperficial content of the field.

A field conſiſting of ten unequal ſides, viz. ABCDEFGHIK, whoſe dimenſions in chains and links are as follows; to know the ſuperficial content is required.



DIMENSIONS.

The trapezium ABIK.

872.4736

5.96 ———— 3.40
8.68 ———— 4.48
13.84 ———— 0

The triangle BHI.

217.7280

3.60 ———— 2.80
9.72 ———— 0

The trapezium BCDH.

690.7520

3.00 ———— 3.00
5.88 ———— 5.60
10.05 ———— 0

The trapezium DFGH.

594.9440

4.46 ———— 4.00
6.30 ———— 4.96
8.30 ———— 0

The triangle DEF.

220.5760

2.46 ———— 4.52
6.10 ———— 0

THE WORK.

The trapezium ABIK.

3.401 perpendicular
4.482 ditto

7.88 ſum of the perpendiculars
13.84 diagonal

3152
6304
2364
788

109.0592 double area
8

872.4736 poles

The triangle BHI.

9.72 diagonal
2.80 perpendicular

77760
19440

272160 double area
8

217.7280 poles

The trapezium BCDH.

3.001 perpendicular
5.602 ditto

8.60 ſum ditto
10.04 diagonal

3440
86000

86.3440
8

69.07520

The trapezium DFGH.

4.001 perpendicular
4.962 ditto

8.96 ſum
8.30 diagonal

26.880
71680

74.3680
8

594.9440

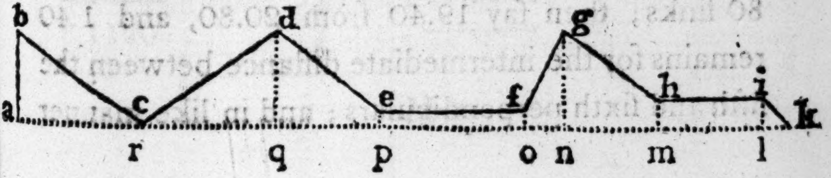
The triangle DEF.

```
     4.52 perpendicular
     6.10 diagonal
    ------
     4520
    27120
    ------
    275720
         8
   --------
   220.5760
   872.4736
   217.7280
   690.7520
   594.9440
   --------   A  R  P
160)2596.4736(16  0  46
   160
   ---
    996
    960
    ---
     36
```

Enter the field at the corner **A** (though at any other will anſwer the ſame purpoſe); but remember, as before obſerved, always to leave a mark of paper at the place of ſtarting; then take up the trapezium ABIK, enter the dimenſions accordingly, and in like manner meaſure the whole field. Any field may be meaſured by triangles and trapeziums, provided the hedges thereof be ſtraight. But when you propoſe to meaſure any ſuch multilateral or many-ſided field by triangles, &c. ſee that you omit not (as you advance) to leave marks of paper at thoſe angular points which you have ſurveyed, otherwiſe you will probably commit a miſtake, by meaſuring ſome part thereof twice over, or perhaps make ſome omiſſion therein, whereof the conſequence will be equally bad.

I ſhall next introduce a right line offset, wherein I propoſe to give plain and eaſy rules to find the true content thereof, with ſome comparative remarks between this and the method hitherto uſed in caſting up offsets by the pen; but when I ſay an offset being caſt up by the pen, you will ſay, perhaps, all land that is ſurveyed muſt certainly be caſt up thereby in ſome reſpects. I will grant that the pen is an uſeful inſtrument in all ſciences: but mark how it is, and has been, generally uſed by old practitioners in ſurveying.

Let the following figure repreſent the ſide of a large field, being a right lined offset; the content thereof is required.



In order to meaſure theſe offsets, place yourſelf at a, and fix upon a mark in the oppoſite hedge at k; then meaſure the perpendicular ab, and enter it in your field book; return to the point a, and as you are chaining the baſe line ak take up the ſeveral perpendiculars rc, qd, pe, of, ng, mh, li, by the help of your croſs ſtaff, and enter the ſame in your field book; obſerve to enter not only the length of each perpendicular, but alſo the particular place on the baſe line where each was erected, as appears in the dimenſions.

To find the true area, by the pen, of all offsets thus taken up, obſerve this general rule.

RULE.

Multiply the ſum of every two adjacent perpendiculars by the intermediate diſtance upon the baſe line, and half the product is the content. The intermediate diſtance upon a baſe line is found by ſubtracting the foregoing length or diſtance from the following: for inſtance; if it was required to know the intermediate diſtance between the fifth and ſixth perpendiculars, the fifth perpendicular riſes on the baſe line at 19 chains 40 links, that is to ſay, 19 chains 40 links from the beginning at a; the ſixth riſes at 20 chains 80 links; then ſay 19.40 from 20.80, and 1.40 remains for the intermediate diſtance between the fifth and ſixth perpendiculars; and in like manner proceed to find the intermediate diſtance between every two adjacent perpendiculars in any offset whatever.

DIMENSIONS.

No.	C.	L.	C.	L.
1		0	2	40
2	3	12	0	20
3	10	20	2	52
4	14	00	0	70
5	19	40	0	70
6	20	80	2	60
7	24	44	1	06
8	28	28	1	28
9	29	36	0	

See the work:

2.40 1ſt perpendicular
0.20 2d perpendicular
2.60 ſum
3.12 intermediate diſ.
520
260
780
8.1120

0.20 2d perpendicular
2.52 3d perpendicular
2.72 ſum
7.08 intermediate diſ.
2176
19040
19.2576

2.52 3d perpendicular
0.70 4th perpendicular

3.22 ſum
3.80 intermediate diſ.

25760
9660

12.2360

0.70 4th perpendicular
0.70 5th perpendicular

1.40 ſum
5.40 intermediate diſ.

5600
7000

7.5600

0.70 5th perpendicular
2.60 6th perpendicular

3.30 ſum
1.40 intermediate diſ.

13200
3300

4.6200

2.60 6th perpendicular
1.06 7th perpendicular

3.66 ſum
3.64 intermediate diſ.

1464
2196
1098

13.3224

1.06 7th perpendicular
1.28 8th perpendicular

2.34 ſum
3.80 intermediate diſ.

18720
6920

8.7920

1·28 8th perpendicular
1.12 intermediate diſ.

256
128
128

1.4336

8.1120
19.2576
12.2360
7.5600
4.6200 } The ſeveral products collected
13.3224
8.7920
1.4336

2)75.3336 which being divided by 2 gives the number of ſquare chains

10)37.6668 this divided by 10 gives the number of acres

3.7666
4

3.0664
46

A R P
2.6560 3 3 2 the number of acres, roods, and poles required.

Inſtead of taking half the product of the offsets in ſquare chains, as before taught, multiply the ſum of your products by 8, and place that product at the top of the offset to which it belongs. And when you have caſt up all the dimenſions belonging to the field, collect the ſeveral products, and divide that ſum by 160, otherwiſe by 40, and by 4, and the content will ſhew the area in acres and perches.

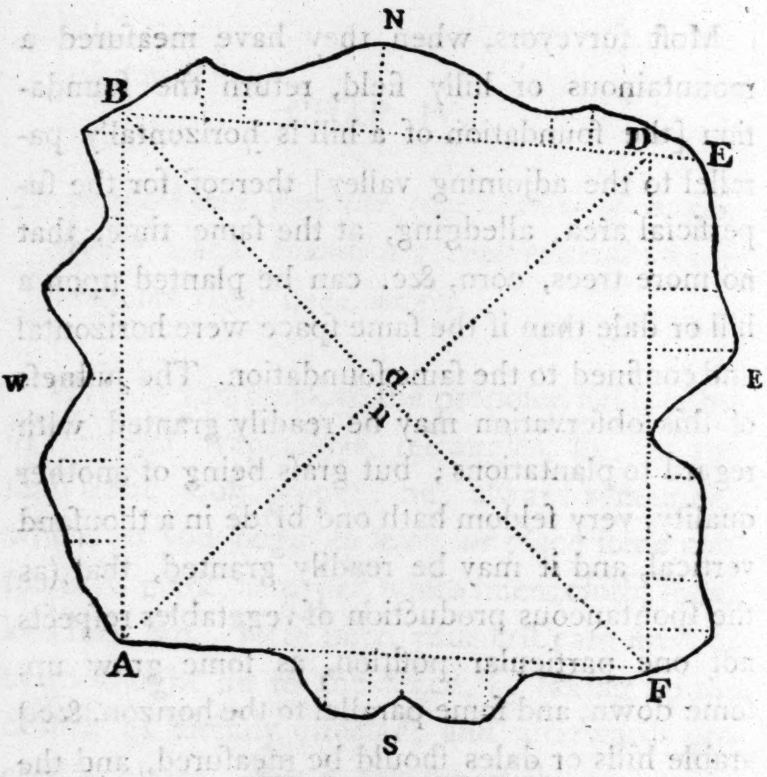
CHAP. IV.

To meaſure and find the true content of any incloſure, whoſe bounds are comprehended under irregular right lined hedges.

WHEN you meaſure the propoſed field, either in triangles, trapeziums, rectangles, &c. as you ſhall think moſt proper; but always remember, whenever you begin to leave or place ſome conſpicuous mark, as paper, white linen, cloth, handkerchief, &c. Here note, your firſt care muſt be to go ſtraight on to the fence, by taking up the offsets, as already directed, and afterwards proceed as above. But if the ſuperficies thereof be very uneven or hilly, ſo that you cannot poſſibly behold the boundaries of the ſame from any one place, nor the marks which you may have therein placed or ſet up, when the right lined offsets were taken; in all ſuch caſes, firſt meaſure what you can conveniently ſee on any ſide of the hill or mountain; which, when done, you may perhaps meaſure the remainder in one figure, if you can behold the marks prefixed when the offsets were meaſured, otherwiſe you are not confined to one or more.

Moſt ſurveyors, when they have meaſured a mountainous or hilly field, return the foundation [the foundation of a hill is horizontally parallel to the adjoining valley] thereof for the ſuperficial area, alledging, at the ſame time, that no more trees, corn, &c. can be planted upon a hill or dale than if the ſame ſpace were horizontal and confined to the ſame foundation. The juſtneſs of this obſervation may be readily granted with regard to plantations; but graſs being of another quality, very ſeldom hath one blade in a thouſand vertical, and it may be readily granted, that (as the ſpontaneous production of vegetables reſpects not one particular poſition, as ſome grow up, ſome down, and ſome parallel to the horizon, &c.) arable hills or dales ſhould be meaſured, and the ſuperficial content thereof returned.

Let it be required to meaſure and caſt up the content of the figure on the following page, which repreſents an incloſure comprehended under unequal ſides.



THE DIMENSIONS.

1ſt Weſt offset left hand. 499¼		2d Station, north offset, left hand. 652	
0	0	0	0
3.02	2	3.40	2.06
6.80	2.83	4.90	1.84
10.00	1	9.90	3.32
13.20	2.86	13.46	2.48
15.90	0.40	16.30	1.20
19.00	1.28	17.70	1.90
19.94	0	19.96	3d ſta. begins on r. h.
		21.60	0

3d Station, eaſt offset, left hand.

527¼

0	0
5.20	2.48
7.28	3.32
10.40	0
12.00	2
15.72	2
17.60	2.52
19.20	0

4th Station, ſouth offset, left hand.

280½

0	0
4.68	0.52
5.92	2.32
7.28	2.40
9.00	1.52
10.30	2.41
12.00	2.06
13.10	0.44
14.20	0
19.60	0

The trapezium.

6151½

0	0
14.00	13.20 R. H.
14.40	13.50 L. H.
28.80	0

See the work of each offset.

Weſt offset, left hand.

3.62	3.18	3.20	3.20
2.00	4.83	3.83	3.86
7.24	958	960	1920
	2544	2560	2563
	1272	960	960
	15.3598	12.2560	12.3520

2.70	3.10	1.28
3.26	1.68	0.94
1620	2480	512
540	1860	1152
810	310	
8.8020	5.2080	1.2032
	7.2400	
	15.3598	
	12.2560	
	12.3520	
	8.8020	
	1.2032	
	62.4210 ½ ſquare chains	
	8	
	499.3680 perches	

North offset, left hand.

3.40	1.50	5.16	3.56
2.06	3.90	5.00	5.80
2040	13500	25.80	28480
6800	4500		17800
7.0040	5.8500		20.6480

2.84
3.68
2272
1704
855
10.4512

3.90
1.90
35100
3900
7.4100
7.0040
5.8500
25.8000
20.6480
10.4512
4.3400
81.5032 ½ ſquare chains
8
652.0256 perches

1.40
3.10
1400
4200
4.3400

Eaſt offset, Left hand.

5.20
2.48
4160
2080
1040
12.8960

2.08
5.80
16640
10400
12.0640

3.12
3.32
624
936
136
10.3584

1.60
2
3.20

3.72	1.88	1.60	
4	4.52	2.52	
14.88	476	320	
	946	800	
	752	320	
	8.4976	4.0320	
		12.8960	
		12.0640	
		10.3584	
		3.2000	
		14.8800	
		8.4976	
		65.9280	½ ſquare chains
		8	
		527.4240	perches

South offset, left hand.

4.68	1.24	1.36	1.72
0.52	2.84	4.72	3.92
936	496	272	344
2340	992	952	1548
2.4336	248	544	516
	3.5216	6.4192	6.7424

1.30	1.70	1.10	1.10
3.93	4.47	2.50	0.44
320	1190	5500	440
1160	680	2200	440
390	680		
		2.7500	4840
5.1090	7.5990		2.4336
			3.5216
			6.4192
			6.7424
			5.1090
			7.5990
			2.7400
			35.0588 ½ ſq. ch.
			8
			280.4704 perches

The trapezium.

26.70 perpendiculars

28.80 diagonal

213600

213600

53400

768.9600 half ſquare chains

8

6151.6800 perches

		A	R	P
Weſt offsets - - - -	499¼	50	2	30½
North offsets - - - -	652			
Eaſt ditto - - - - - -	527¼			
South ditto - - - - -	280½			
Trapezium - - - - -	6151½			

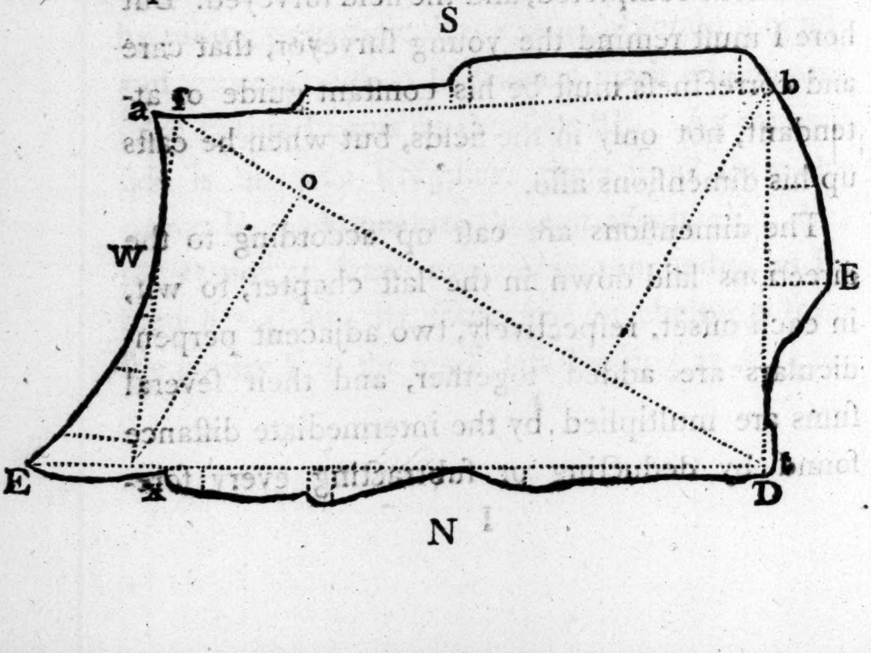
Directions to take the dimenſions of this field.

Firſt fix a mark at A in the ſouth ſide of the field, and then begin with and take up the weſt offsets by chaining the baſe line AB (or firſt ſtation), and when you come to the place B, ſet up a mark, or ſtake; but be careful to take up the perpendiculars that ariſe from the ſtation (or baſe line) to the ſubtending corners; then ſtraighten the north ſide of the field, which you may do by fixing on a mark at E on the eaſt ſide: but if there is nothing remarkable in the hedge, at or near that place, you muſt ſend your chainman to fix or ſet up a mark thereat, having taken up the north offset as you chained the ſtation, E (or baſe line), by raiſing perpendiculars to the ſubtending bends and corners, and at D leave a mark where your third ſtation begins on the line BE. As the eaſt ſide is likewiſe irregular, chain from D to the corner E, and meaſure the eaſt offsets alſo; but forget not to leave a mark in the hedge at F: then ſtraighten the ſouth ſide by chaining from the corner F to the mark left ſtanding at A; proceed as before, till you have finiſhed the ſame, then is the irregular field reduced to four unequal ſides, which meaſure the ſame as a trapezium.

Having finiſhed the ſouth offsets, return back to F, then chain from F to the mark at B for a diagonal line to the trapezium FABD; and, as you advance, omit not to take the perpendiculars on the right and left hand found by your croſs ſtaff, that is to ſay, the place where they ſhould be raiſed, namely, at 14 chains upon the diagonal line FB; at n a perpendicular will fall upon the mark at D, on your right hand, which being meaſured, return to your croſs ſtaff, and at 40 links farther at P, upon the ſame line, another perpendicular muſt likewiſe be raiſed to the mark left in the hedge at A, on the left hand, which being meaſured and entered, return to your croſs ſtaff, and finiſh the diagonal line FB: then are your dimenſions completed, and the field ſurveyed. But here I muſt remind the young ſurveyor, that care and correctneſs muſt be his conſtant guide or attendant, not only in the fields, but when he caſts up his dimenſions alſo.

The dimenſions are caſt up according to the directions laid down in the laſt chapter, to wit, in each offset, reſpectively, two adjacent perpendiculars are added together, and their ſeveral ſums are multiplied by the intermediate diſtance found by deducting or ſubtracting every foregoing length on the baſe line (or ſtation) for a multiplier; but as you proceed in caſting up the dimenſions, draw a daſh with the pen acroſs each of theſe lines that are between the baſe and perpendiculars, which will prevent your caſting the ſame twice over.

Note.—As all the following examples of this kind, relating to offsets, &c. are meaſured and caſt up as above directed, I therefore think it needleſs to inſert the different operations that follow, ſince it will give the ingenious reader an opportunity (if he chuſes) of becoming very perfect and ready in caſting up the ſame; ſo that if the reſult of his work ſhould happen to diſagree with the reſult at the top of the dimenſions, he may then take it for granted, that a miſtake is committed in his proceedings, and therefore ſhould re-examine his figures.—The content of this triangular incloſure is required.



To determine which way the aforeſaid field could be moſt expeditiouſly ſurveyed, would be to little purpoſe; for ſeeing that any irregular field will admit of great variety (with regard to taking the dimenſions thereof), it therefore matters not how the ſame be ſurveyed, provided care be taken not to omit, or meaſure any part twice. However, I would recommend to the young ſurveyor, if the field or land be horizontal, to take the largeſt trapezium or rectangle, &c. poſſible, and let the offsets be as ſmall as the boundaries will conveniently admit of; but in curvilinear ſuperficies, or mountainous ground, the ſurveyor cannot be his own carver.

Directions to take the dimenſions of the foregoing field.

Firſt. Suppoſe you entered the incloſure at the corner a, (though it matters not where you enter, or where you begin) looking along the north ſide thereof, the irregularity of the fence tells you it muſt be ſtraightened, which you will effect by chaining the baſe line a b, and taking up the north offsets on the left hand; and when you have meaſured the firſt ſtation line to the corner b, then ſet off your ſecond ſtation towards D, and take up your eaſt offsets thereon at the point t: on your right hand begin the third ſtation, at which place leave a mark, and chain to the mark at D; afterwards return to t, and chain to the mark at E, and take the ſouth offsets thereon; and at x begin your fourth ſtation, at which place leave a mark; and after you have finiſhed the line t E return to x, and meaſure the baſe line x f, and take up the weſt offsets thereon: ſo you have finiſhed your four ſtations. The next is to meaſure the trapezium f b t x, which at f ſet off your diagonal to the corner t; then take up the right hand offset to the corner x, and left hand offset to the corner b, and finiſh your diagonal to t, then you will have the dimenſions of the field complete. When you are to map your dimenſions, obſerve not to enter any thing in the right hand column, except remarks, and an offset upon an offset when it occurs, and properly enter it at and upon the perpendicular it lies, with a daſh or ſmall line drawn between the perpendicular and the place where the ſame is entered.

Mr. Goodwin's land.

Sandy field dimenſions,
Auguſt 26, 1797.

North offsets, left hand,
1ſt ſtation.

397

0	0
5.25	0
5.68	1
10.97	1
11.70	1.64
21.40	1.85
22.94	0

South offset, left hand,
3d ſtation.

229¼

0	0
5.12	0.62
9.10	0.63
11.48	0
16	1.30
17	0.80
21.08	0.80
22.20	0.40
22.30	0
23.60	0

4th ſtation begins.

25.23	0.40
27.60	0

Eaſt offset, left hand,
2d ſtation.

198

0	0
3.60	2
7.43	2.40
11.22	0.0
12.80	0.0
14.08	0.40

3d ſtation begins.

14.60	0

Weſt offset left hand,
4th ſtation.

178

0	0
0.92	3
3.60	1.40
5.80	0.40
7.60	0
11.	0
13.40	0.80

4th ſtation ends.

Trapezium	4273
North offsets	397
Eaſt ditto	198
South ditto	229¼
Weſt ditto	178

160)5275¼

The trapezium fbtx.

4273

0 —— 0

5.70 —— 12.38 r. h.

18.44 —— 12.40 l. h.

25.60 —— 0

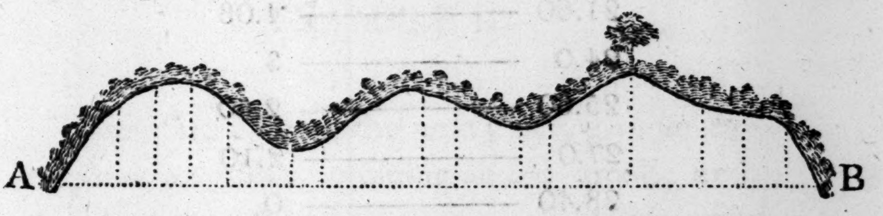
A	R	P	
32	3	35¼	the contents of the field.

CHAP. V.

How to meaſure and find the true content of a circular or curved line offset; alſo to find the content of the moſt irregular field.

EXAMPLE I.

REQUIRED the content of the following figure, which may repreſent an offset taken up in the ſide of a field.



In this and all other offsets you muſt make as many perpendiculars upon the baſe line to the ſubtending hedge, or fence, ſo that, if a right line was drawn from the end of any one perpendicular to the next (or either ſide), it would neither exclude any part of the field or land you are about to meaſure, nor include any of the adjacent.

DIMENSIONS.

1135¾

0	0
2.32	3
3.70	3.74
4.84	3.80
6.30	3.28
8.80	1.30
98.0	1.60
12.30	3.20
13.70	3.50
14.92	3.10
17.20	2.0
18.20	2.30
21.60	4.08
24.0	3
25.60	2.60
27.0	2.10
28.40	0

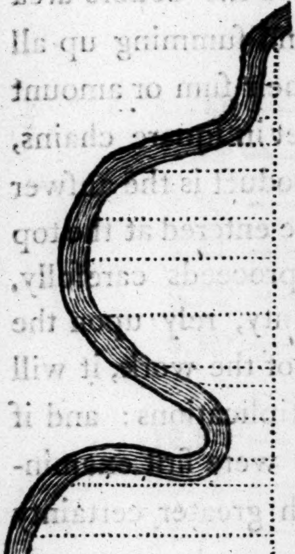
A R P

160)1135¾(7 0 15¾ the area required.

This, and all other examples of the kind, are caſt up the ſame as in the laſt chapter. The ſum of every two adjacent perpendiculars multiplied by the intermediate diſtance upon the baſe line (found by ſubtracting every foregoing number from the next ſucceeding), gives the double area thereof; then, by collecting and ſumming up all thoſe ſeveral areas together, their ſum or amount is the double area of the offset in ſquare chains, which multiply by eight, the product is the anſwer in poles or perches, and muſt be entered at the top of the offset. Whoever thus proceeds carefully, may, with the greateſt certainty, rely upon the reſult; but, for a farther proof of the work, it will be proper to prove the multiplications: and if the additions and ſubtractions were firſt examined, the proceedings might with greater certainty be depended upon.

EXAMPLE II.

I therefore ſhall, in the next place, give an example of an offset adjoining an old brook; and, that the young ſurveyor may more perfectly comprehend the figure and dimenſions of this irregular ſpace, I have made uſe of a ſcale of 16 poles to an inch: all the other plans are taken from a ſcale of 32 poles to an inch.



The foregoing example of of a brook ſide, will ſufficiently direct the young ſurveyor, as therein is a ſpecimen of entry which will qualify him to meaſure the moſt irregular boundaries, and, by the dimenſions caſt up with the pen, diſcover the true area of the ſame; ſo that if a meadow, or any other incloſure, was bounded on all or any of its ſides by a river or brook, the ſurveyor need not do more than, firſt, to ſtraighten the ſides thereof; by which means the ſame is reduced to a triangle, trapezium or an irregular polygon, according to the ſurveyor's pleaſure.

DIMENSIONS.

709¾

0	0
0.60	0.60
1.74	0.75
2.70	0.72
3.33	1.
3.60	3.26
4.10	3.84
5.40	4.12
6.10	3.75
6.43	3.52
6.63	3.00
6.80	0.80
7.61	0.72
8.30	0.93
9.20	1.36
9.31	4.00
9.98	4.52
10.88	4.43
11.97	3.75
12.25	0.85
13.	0.83
13.70	1.43
14.04	2.41
14.98	3.25
16.	3.52
16.86	3.35
17.60	2.60
18.10	1.30
18.65	0.40
19.30	0.24
19.80	0.28
20.12	0.

An offset on do. R. H.

3¾

0	0
1.25	0
2.10	0.20
2.50	0.25
3.00	0

An offset on do. L. H.

7¼

0	0
1.71	0
2.85	0.31
3.33	0.37
4.00	0

An offset on do. R. H.

8½

0	0
1.47	0
2.40	0.32
3.02	0.42
3.75	0.

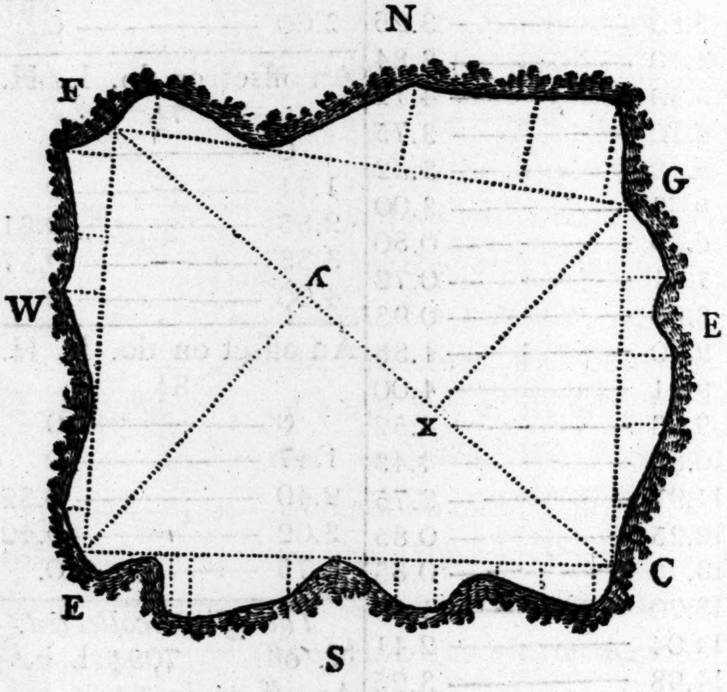
The offsets collected.

N. off.	709¾	l. h.
An off. on do.	3¾	r. h.
L.H.off.on do.	7¼	
R. H. off.	8½	

a. r. p.
160)729¼(4. 2. 9¼
640 Content
40)89(2
80
9

EXAMPLE. III.

Let the following figure repreſent a field; the content in acres, roods, and poles is required.



DIMENSIONS.

South offsets, left hand, 1ſt. ſtation.

403¾

0 —— 0
0.90 —— 1.66
2.88 —— 1.32
4.46 —— 0.60
6.80 —— 1.80
8.30 —— 1.60
10.50 —— 0.20
12.30 —— 1.66
16. —— 2.34
16.70 —— 2.20
17.50 —— 0
19.26 —— 0.94
19.96 —— 0

Weſt offsets, left hand, 2d ſtation.

245¾

0 —— 0
1.66 —— 1.20
4.72 —— 0
9.60 —— 1.60
11.96 —— 1.14
14.94 —— 1.90
15.90 —— 0

North offsets, left hand, 3d. ſtation.

655¼

0 —— 0
1.24 —— 1.44
5.54 —— 0
10.80 —— 3.32
15.30 —— 3.54
18.40 —— 3.66
19.00 —— 0

Eaſt offsets, left hand, 4th ſtation.

282

0 —— 0
2.72 —— 1.86
4.00 —— 1.10
5.70 —— 2.00
8.20 —— 2.00
11.32 —— 0.70
13.40 —— 0

Trapezium, 4566¼,

0 —— 0
8.80 —— 10.26 r.h.
15.30 —— 12,70 l.h.
24.86 —— 0.

The offsets collected.

```
     4566¾
      403¾
      245¾
      655¼
      282
     ———— A. R. P.
160)6153(38 1 33 the content required
     480
     ————
     1353
     1280
     ————
     40)73(1
        40
     ————
        33
```

The field work of the foregoing figure explained.

Firſt. You are ſuppoſed to enter the field at C, and chain from C to E, and take up the ſouth offſet to the left hand.

Chain the ſecond ſtation from E to F, and take up the weſt offſet thereon.

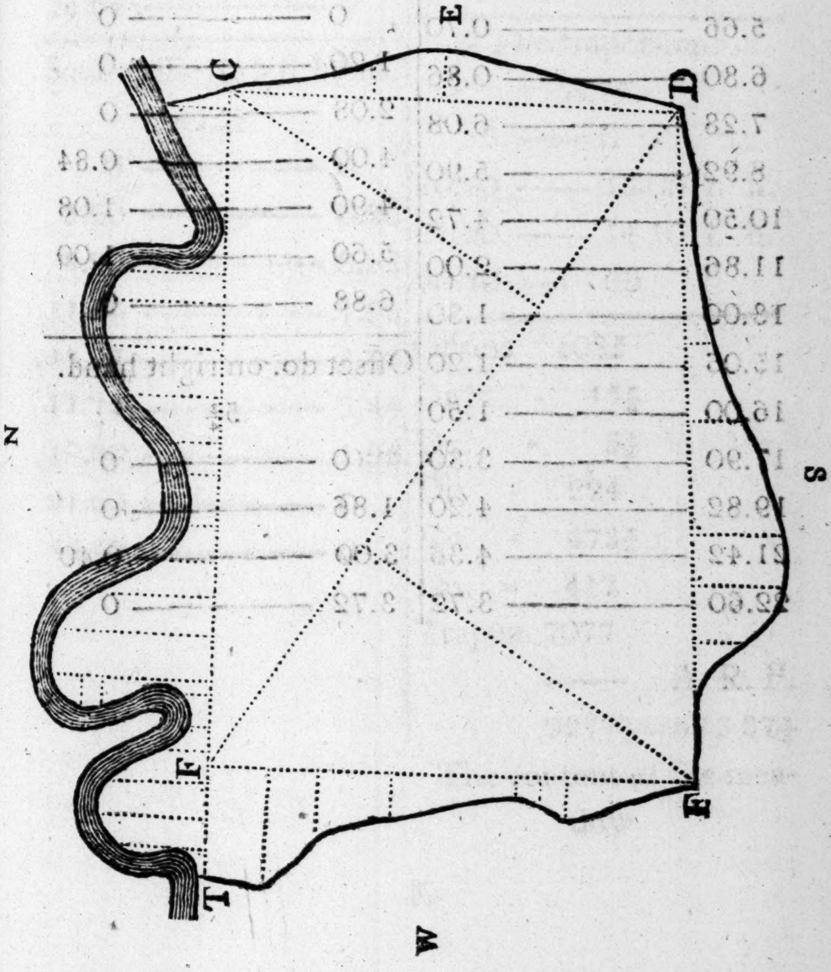
Then chain the third ſtation from F to G, and take up the north offſets.

Chain the fourth ſtation from G to C, and take up thereon the eaſt offſets.

And, *laſtly*, meaſure the trapezium CEFG, by chaining the baſe line CF, and take the right hand offset x g, and the left yE. See the content of each offset entered at the top of the ſeveral dimenſions.

EXAMPLE IV.

Let the following figure repreſent a meadow, bounded on one ſide by a river; the content thereof is required.



DIMENSIONS.

North offsets, left hand.

1035¾

0	0.20
0.76	0.60
1.00	2.86
2.00	4.10
3.46	4.00
4.80	2.10
5.66	0.70
6.80	0.86
7.28	6.08
8.92	5.90
10.50	4.72
11.86	2.00
13.00	1.30
15.06	1.20
16.00	1.50
17.90	3.30
19.82	4.20
21.42	4.36
22.60	3.72

Offsets do. on left hand.

45¾

0	0
1.20	0
2.08	0
4.00	0.84
4.90	1.08
5.60	1.00
6.88	0

Offset do. on right hand.

5¾

0	0
1.86	0
3.00	0.40
3.72	0

23.10 ——— 0.60
24.20 ——— 0.00
28.80 ——— 2.40
29.60 ——— 0

East offsets, left hand.

224

0 ——— 0
5.20 ——— 1.10
7.80 ——— 1.70
16-64 ——— 0

South offsets, left hand.

$473\frac{1}{4}$

0 ——— 0
5.20 ——— 0.26
8,80 ——— 0.92
11,80 ——— 1.96
15.97 ——— 3.40
17.74 ——— 3.44
19.80 ——— 1.96
21.60 ——— 0
25.40 ——— 0

West offsets, left hand.

417

0 ——— 0
4.46 ——— 1.80
5.80 ——— 1.06
6.70 ——— 0.50
11.40 ——— 1.80
14.00 ——— 1.40
15.70 ——— 4.34
18.00 ——— 0

The trapezium.

7077.

0 —— 0
10.20 —— 15.00 r. h.
21.20 —— 14.10 l. h.
30.40 —— 00

Offsets 1035
Ditto - $45\frac{1}{4}$
Do. - $5\frac{3}{4}$
Do. - 224
Do. - $473\frac{1}{4}$
Do. - 417
Trapez. 7077

—— A. R. P.

$9277\frac{3}{4} = 57\ 3\ 37\frac{3}{4}$

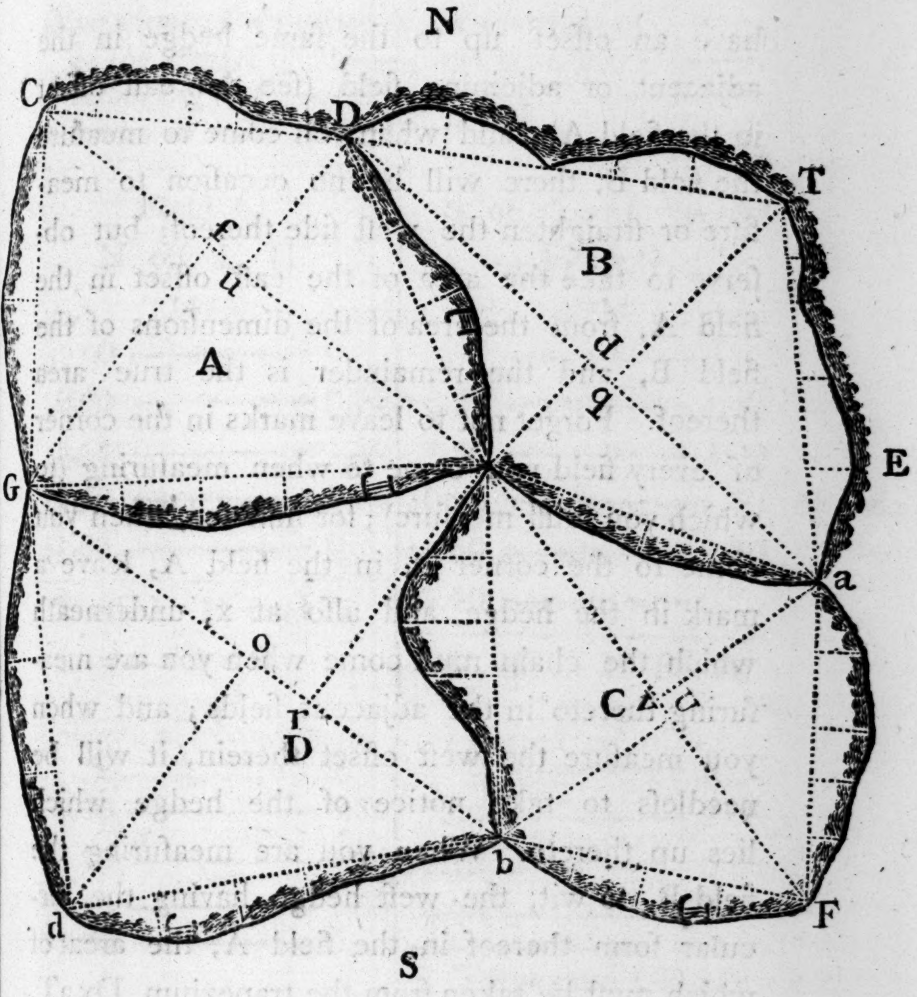
The content of the meadow.

Direction in the foregoing meadow.

When you come into the meadow, make for the weſt ſide thereof (though any ſide will anſwer the ſame end): then fix on a place in the hedge, ſuppoſe at T, and caſting your eye towards the oppoſite ſide, fix on a mark in the hedge at C, to which place chain, and as you advance take up the left-hand offsets; then chain from C to D, from D to E, and from E to F, taking up at the ſame time the left hand offsets; then meaſure the trapezium CDEF, then are your dimenſions ended, which you may caſt up in the field, if you think proper.

EXAMPLE V.

Let it be required to meaſure the following ſmall eſtate, conſiſting of four incloſures, ſo that the dimenſions thereof may be caſt up by the pen, and afterwards planned if deſired; I demand the content of the whole, and of each field ſeverally.



DIMENSIONS.

In meaſuring this eſtate, you muſt be very accurate in your dimenſions, otherwiſe you cannot poſſibly give a juſt return or plan of the ſame; but, here note, if you meaſure an inner offset in one field, there will be no occaſion to have an offset up to the ſame hedge in the adjacent or adjoining field (ſee the eaſt offset in the field A); and when you come to meaſure the field B, there will be no occaſion to meaſure or ſtraighten the weſt ſide thereof; but obſerve to take the area of the eaſt offset in the field A, from the area of the dimenſions of the field B, and the remainder is the true area thereof. Forget not to leave marks in the corner of every field you come to when meaſuring (to which you muſt meaſure); for inſtance, when you come to the corner D, in the field A, leave a mark in the hedge, and alſo at x, underneath which the chain muſt come when you are meaſuring thereto in the adjacent fields; and when you meaſure the weſt offset therein, it will be needleſs to take notice of the hedge which lies up thereto. When you are meaſuring the field B, to wit, the weſt hedge having the circular form thereof in the field A, the area of which muſt be taken from the trapezium DxaT, and the remainder being added to the north, eaſt, and ſouth offsets in the field B, the ſum will be the true area thereof: then proceed in like manner in the fields C and D, till you have completed the whole. See the dimenſions.

Dimenſions of an eſtate in the townſhip of T——, in the Pariſh of P——, and county of K——, belonging to I—— G——, Eſq. W—— F—— tenant at will, Auguſt 24th, 1798.

Field A.
N. off. L. H.
144¼

0	0
2.00	0.95
5.64	1.30
7.30	0.96
11.66	0

E. off. L. H. field A.
—Field B.
208

0	0
3.60	0.80
6.80	1.94
10.90	1.00
13.20	0,

S. off. L. H. Fd. A.
— Field D.
291¾

0	0
6.28	1.40
7.60	1.60
10.80	1.70
13.50	1.30
17.40	0

W. off. L. H. Fd. A.
249¾

0	0
7.00	2.00
12.72	0.80
14.26	0

Trapezium CD xG
3078.

0		0
8 30	R. H.	11.78
9.74	L. H.	6.20
21.40		0

Field B.
R. H. Offset, S.
— Field C.

160¾

0 ———— 0

3.24 ———— 0.90

6.50 ———— 1.30

9.00 ———— 0.90

13.08 ———— 0

R. H. Offset E. Fd. B.

158½

0 ———— 0

4.24 ———— 1.60

7.60 ———— 1.20

10.60 ———— 0

12.00 ———— 0.60

14.40 ———— 0

R. H. Offset, N. Fd. B.

197

0 ———— 0

3.60 ———— 1.30

6.40 ———— 0.60

8.90 ———— 0

13.00 ———— 1.84

15.60 ———— 1.06

16.40 ———— 0

Trapezium DTax.

2660

0 ———— 0

12.40 R. H. 5.24

13.30 L. H. 8.60

24.20 ———— 0.

Field C.
E. Offset L. H.

254

0 ———— 0.

2.66 ———— 1.70

5.66 ———— 2.20

7.40 ———— 1.80

9.60 ———— 1.20

12.00 ———— 0.

W. Offset, L. H. FdC.
— Field D.

347¾

0 ———— 0

2.20 ———— 0

2.80 ———— 0.40

4.00 ———— 0.80

6.20 ———— 2.40

8.20 ———— 3.40

10.60 ———— 2.40

14.00 ———— 0.

S. Offset L. H. Fd. C.

189½

0		0
3.20		7.20
6.20		1.80
8.80		1.00
11.98		0

Trapezium xbFa.

2446½

0		0
10.80	L. H.	7.50
11.52	R. H.	7.70
20.12		0

Field D.

S. Offset, L. H.

303¾

0		0
6.40		0.55
7.20		1.00
9.60		1.60
12.88		1.50
15.60		0.80
16.30		0

W. Offset L. H. Fd. D.

318¼

0		0
1.40		0.80
5.20		1.60
9.48		2.14
14.60		0.40
15.80		0

Trapezium Gdbx.

4084¾

0		0
11.00	R. H.	11.80
13.80	L. H.	11.20
22.20		0

The field notes explained.

Suppoſe you enter into the field A, at the mark C, from whence (after you have ſet up a mark) chain to the corner D, and take up the left hand offsets; then chain from the corner D, to the corner x, taking up the eaſt offsets; but here obſerve, that theſe offsets project into the weſt ſide of the field B, and therefore you need not ſtraighten the hedge on both ſides; but take care to mention at the top of the dimenſions, Minus Field B, thus abbreviated, — Fd. B; in like manner chain from x to the corner G, and take up the ſouth offsets thereon, and take care to place at the top of the dimenſions, — Fd. D, as before taught; alſo chain from G to the corner C, and take up the weſt offsets; then meaſure the trapezium c D x G: proceed from c towards x, and take up the right and left hand offsets, then field A is finiſhed. At the mark x enter into the field B, and after you have obſerved the form thereof, chain from x to the corner a, and take up the ſouth offsets thereon, and mention at the top of the dimenſions, — Fd. C.; from a, chain to the corner T, and take up the eaſt offsets; alſo from T chain to the corner D, and take up the north offsets thereon; then meaſure the trapezium D x a T, by chaining from D to the corner a, and taking up the right and left hand offsets; then at the mark a, enter the field C, and chain from a, to the corner F, and take up the eaſt offsets; alſo from F chain to the corner b, and take up the ſouth offsets; from the mark at b chain to the corner x, and take up the weſt offsets thereon, and place at the top of the dimenſions, — Fd. C. Then chain from the trapezium x a F b, from x to the corner F, and take up the left and right hand offsets; return to the mark at b, enter the field D, chain from b to the corner d, and take up the ſouth offsets thereon; from d chain to the corner G, and take up the weſt offsets; alſo meaſure the trapezium G x b d, and chain from G to the corner b, and take up the right and left hand offsets, and you have finiſhed the whole.

In this example, I have deſignedly omitted in the field notes, remarks, as ponds, pits, timber, buildings, &c. which might perhaps have occurred, being apprehenſive the ſame would rather confuſe than edify in this place: moreover, I have directed to meaſure each incloſure ſeparately, though contrary to that correct and expeditious method of chaining a main line acroſs an eſtate, and meaſuring the incloſures ſeverally that you paſs through, as they are met with, on the right and left hand, whereby a plan with leſs trouble may be drawn from the dimenſions ſo taken.

The account of the dimenſions.

Field A,	North offsets left hand	144¼
	Eaſt offsets ditto	208
	South offsets ditto	291¾
	Weſt offsets ditto	249¾
	Trapezium C D x G	3078
		9971¾
Field B.	Right hand offsets ſouth	160¾
	Right hand offsets eaſt	153½
	Right hand offsets north	197
	Trapezium D T a x	2660
		3171¼
	— Eaſt offsets left hand, Fd. A	208
		2963¼
Field C.	Eaſt offsets left hand	254
	South offsets ditto	189½
	Weſt offsets ditto	347¾
	Trapezium x b F a	2446½
		3237¾
	— Right hand offsets Fd. B	160¾
		3077

Field D. South offsets left hand - - - - 303¾
Weſt offsets ditto - - - - - 318¼
Trapezium cdbx - - - - - 4084¾

4706¾
— South offsets l. h. Fd. A 291¾ } 639½
— Weſt offsets l. h. Fd. C 347¾ }

4067¼

The amount of the whole eſtate, with the names of each incloſure.

	A	R	P
A, Barnfield 3971¾ - - - - - -	24	3	11¾
B, Horſe paſture 2963¼ - - - - -	18	2	3¼
C, Oak field 3077 - - - - - -	19	0	37
D, Cow paſture 4067¼ - - - - -	25	1	27¼
Total	87 .	3 .	39¼

Admit it was required to meaſure (with the chain only) any quantity of land, the number of the cloſes ever ſo many, and the form of them ever ſo irregular, by the conciſe and expeditious method of taking a main line, and afterwards to plan the ſame, from which a map may be obtained.

Directions to be obſerved when main lines are uſed, ſome of which directions reſpect meaſuring, and the other mapping.

Meaſure or chain a main line ſome way acroſs the eſtate you are to meaſure, whereon perpendiculars may or can be erected on the right and left hand, to the ſubtending corners or right angles in each and every incloſure you meet with in chaining or advancing through the ſame; but if you ſhould happen to be obſtructed by pond, river, building, or any thing elſe, you may at the brink of the pond, or pit, ſtretch the chain to the right or left, (which ever is moſt convenient) at right angles to the line you are meaſuring; and at the end of that chain, &c. you may proceed parallel to your firſt line, until you are paſt the pond; then one chain, &c. at right angles, on the ſide the pond lies, will bring you in a direction with your firſt line.

At pleaſure you may fix at any part of the boundaries, and from there chain the above mentioned line quite acroſs the eſtate (it matters not whether a meridian, parallel, or compound line); which, when you are chaining or meaſuring, carefully obſerve to take the dimenſions of each incloſure that you paſs through.

Having finiſhed this main line, and the dimenſions of each field, caſt up by the ſame; and afterwards, with ſcale and dividers, plan the field notes; which done, repair to that part of the eſtate unmeaſured (whether on the right or left hand), and meaſure it alſo, either with another main line or otherwiſe, as appears moſt convenient: caſt up and plan thoſe dimenſions with the former, and in like manner proceed until the dimenſions of the whole be completed. But in meaſuring any line (perpendicular to your main line) which excludes a part of the field wherein the ſame is taken, whether to the right or left hand thereof, the ſame muſt be taken up as an offset upon an offset, and entered, as already directed, in its proper place: this being done, and you perceive any other part or parts of the field which thoſe lines that are perpendicular to the main line comprehend or include, in that caſe meaſure the ſame diſtinctly, as offsets upon offsets, or otherwiſe, till there is no part omitted or left out.

It matters not whether you caſt up the dimenſions before or after they are planned; but ſee that you leave not the premiſes before the plan is accurately finiſhed; I mean, before you have noted and inſerted every thing remarkable therein, otherwiſe the map thereof will be as imperfect as the plan; for from the plan the map is obtained.

Return the ground plot (only) of all the edifices, buildings, &c. except you have orders to ſhew the elevation of ſome beautiful edifice, ſuch as the manor houſe, hall, &c. which ſhould not appear in the identical place where the ſame ſtands, but in ſome vacant corner or place of the map, laid down from as large a ſcale as that vacancy would admit of; for if erected or drawn upon the foundation or ground plot, according to its real ſize, that is to ſay, projected from the ſame ſcale, the beauty of the edifice will be rendered thereby almoſt inconſpicuous; and if it be drawn or laid down (where its real foundation is) from a large ſcale, the adjoining gardens, folds, cloſes, &c. will conſequently be concealed or covered thereby, which induces me to recommend vacancies to repreſent the elevation of buildings in.

Having heretofore given ample directions and cautions to young practitioners, concerning the true method of meaſuring and planning, I ſhall now proceed to Example VI. There are not only ſingle fields to be meaſured, but care muſt be taken how they adjoin to the adjacent incloſures, ſo that the ſame may be accurately planned. However, the ſurveyor hath this advantage, when many conjoined fields are to be ſurveyed; for having meaſured any or all the ſides of one field, though extremely irregular, thoſe hedges that intercept the adjacent incloſures will appear, when that field which he has meaſured is planned. If your orders be to return a map, wherein the contents muſt not appear, which often happens, and eſpecially when large demeſnes, manors, &c. are to be ſurveyed; in that caſe, get a reference book, with as many leaves therein as the ſize of the eſtate ſhall require, and place a letter or number in each field that is repreſented in the map, which will refer to the name and quantity thereof in the reference book, the ſame letters or numbers being put therein; and if any manor, &c. conſiſt of ſeveral tenements, the ſhading in the map ſhould diſcover the ſame at firſt ſight.

When buildings, folds, pond, wood, or whatever elſe that is inacceſſible do occur, or interpoſe, between any two perpendiculars, the true area of the ſame may be thus obtained. From the area of the ſpace that thoſe two perpendiculars include or comprehend, deduct the area of the circumjacent offsets that lie between the main line, thoſe perpendiculars, and the buildings, gardens, folds, &c.; the remainder will be the area of the inacceſſible ground, water, &c. Whenever any two perpendiculars are met with at the ſame place, one of which is occaſioned by a road or lane, in caſting up the dimenſions, that which reſpects the lane muſt not be noticed, as it is deſignedly taken to plan the ſame by; but in calculating the area of the road, is then conſidered, if the ſame hath not been before particularly and diſtinctly meaſured.

In drawing or forming a plan, let all thoſe lines that denote boundaries and fences, be drawn with a black lead pencil; and ſee that all other lines be drawn with one of the points of your dividers (guided by your ſcale); which laſt mentioned lines I term or call by the name of obſcure, occult, or dry lines: and if a miſtake ſhould happen to be committed in drawing the plan, a little white bread will take out the fence or pencilled lines; but if you find the boundaries correct, then draw or trace them off with pen and ink.

EXAMPLE VI.

Let plate 3 repreſent the ground plot of an eſtate belonging to W—— P——, Eſq. and it be required to meaſure the ſame with the ſame only, ſo that the dimenſions thereof may be caſt up by the pen, and afterwards an accurate plan delineated therefrom, whereby a map properly embelliſhed, and the true content of each field inſerted therein may be obtained. See the map, Plate 4.

Dimenſions of an eſtate in F——r, in the county of E——x, belonging to W—— P——, Eſq. June 12, 1798.

Bridge mea. L. H. off. W.
493¼
0 ————— 0.
0.42 ————— 2.50
4.20 ————— 2.40
8.30 ————— 2.40
12.00 ————— 1.00
15.10 + h < lo. mea. 0
1556¾
18.80 ————— 3.80
22.48 ————— 6.20
24.66 ————— 6.60
27.40 ————— 6.40
30.40 ————— 4.80
34.48 ————— 1.20
37.20 ————— 0
40.90 ————— 2.60
43.50 < gre. mea. 5.00*
46.10 + h gre. mea. 5.80*
528¾
48.60 ————— 5.40
51.20 ————— 3.60
53.40 ————— 1.40
55.0 ————— 0.60
56.25 ————— 0.25
5.80 + h calves mea. 0
541¼
58.0 ————— 0.80
60.80 ————— 2.20
63.60 ————— 3.00
71.30 ————— 2.30
73.00 ————— 0.00

12 poplar trees E. ſide bridge meadow.
29 willow trees W. ſide long meadow, and 74 oak trees on E. ſide do.
6 willow trees W. ſide calves meadow.

An offset on ditto, long meadow, R. H.
60
0 ————— 0
1.60 ————— 1.56
*5.00 ————— 0

An offset ditto, green meadow, L. H.
108½
0 ————— 0
3.40 ————— 1.72
5.10 ————— 2.20
*5.80 ————— 0

R. H. off. E.
Bridge meadow.
2943½
*0 ——— 15.10
7.30 ——— 10.08
15.10+hlon. mea. *13.40
4397½
22.00 ——— 8.00
27.30 ——— 12.40
40.20 ——— 7.04
46.10+h green mea.*4.40
1402½
49.00 ——— 4.60
51.70 ——— 11.30
58.00+h calv. mea.*7.80
2074
60.40 ——— 6.70
68.30 ——— 11.90
71.80 ———*15.64
73.00 ends 1ft main line 0.

An off. on ditto R. H.
205½
*0 ——— 0
15.10 ——— 1.70
An off. upon that L. H.
21¼
0 ——— 0
*1.70 ——— 1.60

An off. on ditto L. H.
906
0 ——— 0
8.80 ——— 7.80
13.40* ———*1.90
An off. upon that R. H.
12
0 ——— 0
0.84 ——— 0.80
*1.90 ——— 0

An off. on ditto L. H.
17¼
0 ——— 0
3.20 ——— 2.00
*4.40 ——— 0

An off. on ditto L. H.
143½
0 ——— 0
6.50 ——— 2.30
*7.80 ——— 0

An off. on ditto L. H.
230½
0 ——— 1.20
3.10 ——— 1.80
7.20 ——— 1.60
10.80 ——— 0
15. 64 ——— 0*

R. H. off. W.

New cloſe, 2d main line.

385¼
0 ——— 0
3.20 ——— 3.30
6.60 ——— 6.00
1574¼
7.60 + h pond cloſe 6.80*
11.70 ——— 9.00
20.20 ——— 5.00
1181¾
22.80 + h the marſh 11.10*
24.00 < long mea. 12.80
29.20 + h primr. cloſe 9.90*
961¾
36.40 < p.c. & pit ſide 6.90
42.80 + h aſh field 4.20*
1128½
44.50 ——— 3.80
47.02 ——— 7.30
798¼
58.60 + h cow paſt. 4.00*
64.50 ——— 6.40
73.64 ——— 0

---

36 oak trees on S. ſide, cow paſture, with a pit in the hedge between horſe paſture.

47 aſh trees N. ſide new cloſe, and 31 poplars on W. ſide, with a pit in hedge between and ſandy field.

79 oak trees N. ſide, pond cloſe, with a pond near eaſt ſide.

An off. on ditto R. H.

123
0 ——— 0
3.20 ——— 1.00
5.90 ——— 1.00
*6.80 ——— 0

An off. on ditto R. H

213
0 ——— 0
5.00 ——— 2.40
*11.10 ——— 0

An off. on ditto L. H.

554¼
0 ——— 0
7.00 ——— 7.00
*9.90 ——— 0

An off. on ditto L. H.

101¼
0 ——— 0
3.60 ——— 1.80
*4.20 ——— 0

An off. on ditto R. H.

91
0 ——— 0
2.60 ——— 2.60
*4.00 ——— 0

E. off. L. H.
New cloſe.
1440
0 ———— 9.60*
0.40 < ſandy field 12.00
7.60 + h pond fd. 11.80
1987½
10.48 ———— 11.20
17.80 thro' the pond 8.74
22.80 + h the marſh 5.60*
215
24.60 by a pit 4.20
1066¼
29.20 + h primr. cl. 5.60*
37.95 ———— 6.20
1210½
42.80 + h aſh field 3.40*
51.00 ———— 6.00
54.00 ———— 7.40
2307¾
58.60 + h cow paſt. 8.80*
64.10 by ſide of a pit 8.80
71.94 ———— 12.86
73.64 ends 2d main li. 0

An off. on ditto L. H.
53¾
0 ———— 0
4.60 ———— 0.70
*9.60 ———— 0.

An off. on ditto R. H.
264¼
0 ———— 0
11.20 ———— 2.80
*11.80 ———— 0.

An off. ditto R. H.
76
0 ———— 0
*4.40 ———— 1.70
5.60 ———— 0.

An off. on ditto L. H.
188
0 ———— 0
4.20 ———— 4.20
*5.60 ———— 0

An off. on ditto L. H.
48¾
0 ———— 0
3.00 ———— 1.80
*3.40 ———— 0.

An off. on ditto L. H.
314½
0 ———— 0
7.30 ———— 4.80
8.28 ———— 2.70
8.80 ———— 0.

W. off. L. H.

Horſe paſture, 3d main line.

714

0 ——— 0
8.00 ——— 3.90
15.64 + h oak fd. 3.70*

917½

18.40 ——— 5.20
26.0 + h barn fd. 8.00

1169¾

31.20 ——— 9.40
34. 60——— 6.20
35.20 + h orchard. This main line runs along the fence that divides the orchard from the home cloſe, the offsets in the home cloſe are taken from the ſaid fence.

18.93¼

35.20 off. in h clo. 6.10*
43.60 ——— 6.46
47.86 ——— 7.70
52.97 + h ſandy fd. 4.40*

421¾

54.80 ——— 3.48
59.50 ——— 1.60
62.28 ——— 1.00
68.00 ——— 0.64
70.0 ——— 0.60
72.0 ——— 0

An off. on ditto, R. H.

58

0 ——— 0
*3.70 ——— *2.00

An off. upon that, L. H

14

0 ——— 0
*2.00 ——— 0.90

An off. on ditto, L. H.

31¼

0 ——— 0
5.90 ——— 0.64
*6.10 ——— 0

An off. on ditto, R. H.

66¾

0 ——— 0
3.20 ——— 1.90
*4.40 ——— 0

---

7 Walnut trees in ſ. ſide horſe paſture, 40 fir trees E. ſide, and 53 oak trees on N. ſide.

38 oak trees on E. ſide oak field, and 129 oak trees on N. ſide, with pit at W. <, 6 apple trees on E. ſide barn field, with pit at E. <.

R. H. offset E.
Horſe paſture.
2522½
0 ———— 10.60*
2.70 ———— 11.34
5.60 ———— 11.40
9.40 ———— 13.20
13.06 < oak fd. 12.08
24.03¼
1564 + h oak fd. 1188*
22.60 ———— 14.20
26,0+h < bn. fd. 13,00
1774¼
29.20 ———— 11.80
32.20 ———— 11.60
35.20 + h orchd. 1248*
2624¾*
36.20 < of fold 12.60
47.50 < of fold 11.00
2779¼
52.97 + h fdy. fd. 11.40*
55.50 ———— 11.20
58.60 ———— 12.0
62.68 ———— 11.20
66.80 ———— 10.48
69.60 ———— 8.40
70.60 ———— 6.90
72.0 ends the 3d. main line.

An off on ditto, R. H.
127
0 ———— 0
10.00 ———— 1.50
*10.60 ———— 0

An offset on do. R. H.
300¼
0 ———— 0
6.60 ———— 1.96
*11.88 ———— 2.70

An offset on do. L. H.
98¾
0 ———— 0
*12.48 ———— 1.00

This contains the area of the orchard, garden, fold and yard.

An offset do. R. H.
512¼
0 ———— 0
10.96 ———— 5.56
11.20 ———— 4.00
11.40 ———— 0

52 Elm trees on W ſide home cloſe, 6 apple trees on E ſide, 150 oak trees on E ſide ſandy field, and 32 aſh on N ſide.

To meaſure this eſtate, let the ſurveyor repair to any part of the boundaries; ſuppoſe at A in the ſouth ſide of bridge meadow, and there fix a mark in the hedge, and being furniſhed with a chain, croſs ſtaff, meaſuring pins, and a perſon (who ſhould know the name of each incloſure) to lead the chain; then fix a mark on the oppoſite ſide the eſtate as at B, to which place a chain for a main line, and raiſe perpendiculars therefrom to the ſubtending angles, corners, or bends in the hedges in every field the main line paſſeth through; but always remember, when you meaſure any perpendicular, to leave the meaſuring pins, that pertain to the main line, ſtanding with the laſt pin your foreman ſtuck therein, otherwiſe a miſtake in counting your pins or arrows may inadvertently be committed. Your field book being prepared and ruled, in the firſt column thereof, page the firſt, enter thoſe dimenſions that are on the left hand ſide of the main line; and in the firſt column of the next page inſert the right hand dimenſions thereof; the two remaining columns reſerve for remarks, and offſets upon offsets: and for the young learner's thorough information therein, permit me to hand him through the dimenſions taken on the right and left hand ſide of the firſt main line in this eſtate. Having inſerted the owners and tenants names, alſo the townſhip, pariſh, county, and the name of the firſt field, with L. H. in the firſt column, firſt page, and R. H. in the firſt column, ſecond page. If the ſum appears, the ſituation and bearing of the main line may be diſcovered. Whilſt you are thus preparing the field book, you may direct your foreman (if you have no other aſſiſtant) to go and ſet up occaſional marks; this done, begin and ſtraighten the eaſt and weſt ſides of bridge meadow, by taking the right and left offsets, or perpendiculars from the main line. At A on the R. H. is 0 chains; with your croſs ſtaff a perpendicular to the ſide of the cow paſture=15 chains 10 links; at the end of that is an offset upon an offset R. H.=1 chain 70 links, and at the end of that is an offset upon that L. H. to corner of cow paſture at the mark D,=1 chain 60 links; all which enter in your field book in the right hand column. Return to the mark at A, and chain along the main line at 42 links thereon; a perpendicular will ariſe on the left hand=2 chains 50 links; then return to the arrows left in main line, and chain the ſame at 4 chains 20 links; there will ariſe an offset on L. H. 2 chains 40 links; at 7 chains 30 links; there is an offset R. H.=10 chains 08 links; at 8 chains 30 links there is an offset L. H.=2 chains 40 links;* at 12 chains there is an offset L. H=1 chain; at 15 chains 10 links is 0 on the left hand + hedge in < of long meadow, but on the right hand at 15 chains 10 links, there is 0; + 13 chains 40 links; and upon that, two offsets at 8 chains 80 links, there is an offset L. H.= 7 chains 80 links; at 13 chains 40 links there is an offset L. H.=1 chain 90 links; and an offset upon that, at 84 links, there is an offset R. H.= 84 links. Now, admit it was required to know the true content of bridge meadow, the dimenſions are as follow:

L. H. offset W.		An offset on do. R. H.	
439¼		205¼	
0	0	0	0
0.42	2.50	*15.10	1.70*
4.20	2.40	An off. upon that do. l. h.	
8.30	2.40	21¾	
12.00	1.00	0	0
15-10+h < L. M.	0	*1.70	1.60

---

* When you have meaſured 10 chains of the main line, return your 10 arrows to your chain, leader noting the ſame in your field book; and you muſt always remember to return your arrows to the leader at the end of every 10 chains: in the firſt main line you will return your arrows 7 times.

R. H. offset, E.

2943½

0 ——— 15.10*

7.30 ——— 10.08

15.10 + h l. m. 13.40*

An offset on do. L. H.

906

0 ——— 0

8.80 ——— 7.80

*13.41 ——— 1.90

An off. upon that do.

R. H.

12

0 ——— 0

0.80 ——— 0.80

1.90 ——— 0.

The offsets collected.

Perches.

439¼

2943½

205½

21¾

906

12

Area 4528=28 Acres, 1 Rood, 8 Perches.

By which it appears that the true content of the field is 28 acres, 1 rood, 8 perches; and ſo of any other incloſure herein. It would be great prudence in the young ſurveyor, to ſelect the particular dimenſions of every field that the main line paſſeth through, and caſt up the ſame ſeverally, by which their reſpective areas are obtained; and when he finds that he is expert and ready therein, the difficulty which at firſt ſight preſents itſelf (in caſting ſuch dimenſions up by the pen), will ſoon vaniſh. But not to commit a prolix digreſſion, let us proceed in the ſurvey: now return to the arrow ſtanding in the fence corner of long meadow, put your chain through the hedge, and proceed to chain your main line towards B; at 18 chains 80 links in long meadow, is an offset on L. H.=3 chains 80 links; return to your ſtanding arrow, and chain your main line; when you have meaſured 20 chains, return the arrow as before; at 22 chains there is an offset on R. H.=8 chains; at 22 chains 48 links, there is. an offset L. H. =6 chains 20 links; at 24 chains 66 links, there is an offset L. H.=6 chains 60 links; at 27 chains 30 links, there is an offset R. H.=12 chains 40 links; at 27 chains 40 links, there is an offset L. H.=6 chains 40 links; at 30 chains 40 links, there is an offset L. H.=4 chains 80 links; at 34 chains 48 links, there is an offset L. H.=4 chains 80 links; at 34 chains 48 links, there is an offset L. H.=1 chain 20 links; at 37 chains 20 links, there is 0 L. H. ſide of the river; at 40 chains 2 links, there is an offset R. H.=7 chains 4 links; at 40 chains 90 links, there is an offset L. H.=2 chains 60 links; at 43 chains 50 links there is an offset L. H.= 5 chains; there is an offet upon that at 1 chain 60 links; there is a perpendicular R. H=1 chain 56 links; and at 5 chains there is 0 to corner of green meadow; return to the arrow ſtanding in the main line, and proceed towards B; at 46 chains 10 links, croſſeth the hedge into green meadow, there is an offset R. H.=4 chains 40 links; and there is an offset upon that at 3 chains 20 links L. H.=2 chains; and at 4 chains 40 links 0, return to the arrow left in the hedge in green meadow, and there is an offset L. H=5 chains 80 links; there is two offsets upon that; at 3 chains 40 links L. H. an offset= 1 chain 72 links; at 5 chains 10 links there is an offset L. H.=2 chains 20 links; at 5 chains 80 links there is 0 to the river ſide; return to the arrow left in the hedge, and proceed with your main line in green meadow; at 48 chains 60 links there is an offset L. H.=5 chains 4 links; at 49 chains there is an offset R. H.=4 chains 60 links; at 51 chains 20 links, there is an offset L. H.=3 chains 60 links; at 51 chains 70 links there is an offset R. H.=11 chains 30 links; at 53 chains 40 links, there is an offset L. H.=1 chain 40 links, 55 chains, there is an offset L. H. = 60 links; at 56 chains 25 links, there is an offset L. H. = 25 links; at 58 croſſeth the hedge into calves meadow; there is alſo an offset R. H. = 7 chains 80 links; and there is an offset upon that; at 6 chains 50 links, there is an offset L. H = 2 chains 30 links; at 7 chains 80 links, there is 0 to hedge pond field; return to the arrow ſtanding in the hedge, and there is an offset L. H. = 80 links in calves meadow: now proceed on with your main line towards B; at 60 chains 40 links, there is an offset R. H. = 6 chains 70 links; at 60 chains 80 links, there is an offset L. H. = 2 chains 20 links; at 63 chains 60 links, there is an offset L. H. = 3 chains; at 68 chains 30 links, there is an offset R. H. = 11 chains 90 links; at 71 chains 30 links, there is an offset L. H. = 2 chains 30 links; at 71 chains 80 links, there is an offset R. H. = 15 chains 64 links; and upon that there is three offsets; at 0 there is an offset L. H. = 1 chain 20 links; at 3 chains 10 links, there is an offset L. H. = 1 chain 80 links; at 7 chains 20 links, there is an offset L. H. = 1 chain 60 links; at 10 chains 80 links there is 0; at 15 chains 64 links to the corner of new cloſe, return to the arrow ſtanding in the main line, and meaſure to B = 73 chains;

the end of the firſt main line. Now, repair to the unmeaſured part of the eſtate: ſuppoſe we ſet up a mark at C, the north ſide of new cloſe, and another mark at D, the ſouth ſide of cow paſture; then chain from C to D for the ſecond main line, remembering to take the right and left hand offsets in each field, and the offsets upon offsets; at C there is an offset L. H. = 9 chains 60 links to the corner of ſandy field, and ſet up a mark in the hedge at F; then return to the main line, and chain towards D, taking the right and left hand offsets in each field, as before taught; when you have chained the main line to x = 71 chains 94 links, in cow paſture, there is an offset L. H. = 12 chains 86 links, to the corner of horſe paſture; then return to the arrow left in the main line at x, and chain to D = 73 chains 64 links: here ends the ſecond main line (or ſtation). Then proceed as before to the unmeaſured part of the eſtate; ſuppoſe at E, the corner of horſe paſture, and ſet up a mark in the hedge at E, and fix upon the mark left in the hedge at F, the corner of ſandy field; then chain from E to F for the third main line, taking the right and left hand offsets thereon in every field you go through; at 36 chains 20 links, croſſeth the hedge into the orchard, and the end of the garden, at 52 chains 97 links. The orchard, garden, buildings, &c. muſt be meaſured all together like one field, which ſee the field book.

When you have meaſured orchard, garden, &c. return to the main line, and chain to the mark at E in ſandy field; which being finiſhed, concludes the ſurvey.

Abbreviated characters in the field book explained.

+ H, or h	denotes	croſs hedge
Fd.		Field
∢		corner of a field

Here follows the area of the foregoing dimenſions of this eſtate, reſpectively collected from the field book, as they appear therein.

Bridge Meadow.	
L.H. off. W. - -	493¼
R.H. off. E. - -	2943½
S. off. on do. R.H.	205½
E. off. upon that L.H.	21¾
L.H. off. ditto N.	906
R.H. off. upon that E.	12
	4582

Long Meadow.	
L.H. off W. -	1556¾
N. off. on do. R.H.	60
R.H. off. E. -	4397½
N. off. on do. L.H.	70¼
	6084¼

New Cloſe.	
L.H. off. E. -	1440
N. off. on do. L.H.	53¾
S. off. on do. R.H.	264¼
R.H. off. W. -	385¼
	2143¼

Pond Cloſe.	
R.H. off. W. -	1574¼
N. off. on do. R.H.	123
L.H. off. E. -	1987½
S. off. on do. R.H.	76
	3760¾

Green Meadow.

L.H. off. W. -	528¾
S. off. on do. L.H.	102½
R.H. off. E. -	1402½
N. off. on ditto -	143½
	2177¼

Calves Meadow.

L.H. off. W. -	541½
R.H. off. E. -	2074
N. off. on do. L.H.	230½
	2846

Aſh Field.

L.H. off. E. -	1210½
N. off. on do. L.H.	48¾
R.H. off. W. -	1128½
	2387¾

Cow Paſture.

L.H. off. E. -	2307¾
N. off. on do. L.H.	314½
R.H. off. W. -	798¾
N. off. on do. R.H.	91
	3512

The Marſh.

R.H. off. W. -	1181¾
N. off. on do. R. H.	213
S. off. on do. L.H.	554¼
L.H. off. E. -	1640
	2640

Primroſe Cloſe.

L.H. off. E. -	1066¼
N. off. on do. L.H.	188
R.H. off. W. -	961¾
S. off. on do. L.H.	101¼
	2317¼

Barn Field.

R.H. off. E. -	1774¼
N. off. on do. L.H.	98¾
L.H. off. W. -	1169¾
	3042¾

Home Cloſe.

Home cloſe is meaſured from the weſt ſide of the main line.

L.H. main line	1893¼
S. off. on do. L.H.	31¼
N. off. on do. R.H.	66¾
	1991¼

Horſe Paſture.

R.H. off. E. -	2522½
S. off. on do. R.H.	127
L.H. off. W. -	714¾
N. off. on do. R.H.	58
W. off. upon that L.H.	14
	3435½

Oak Field.

R.H. off. E. -	2403¼
S. off. on do. R.H.	300¼
L.H. off. W. -	917½
	3631

Orchard, garden, fold, building, and yard, they are meaſured from the eaſt ſide of the main line.

R.H. main line	2624¾

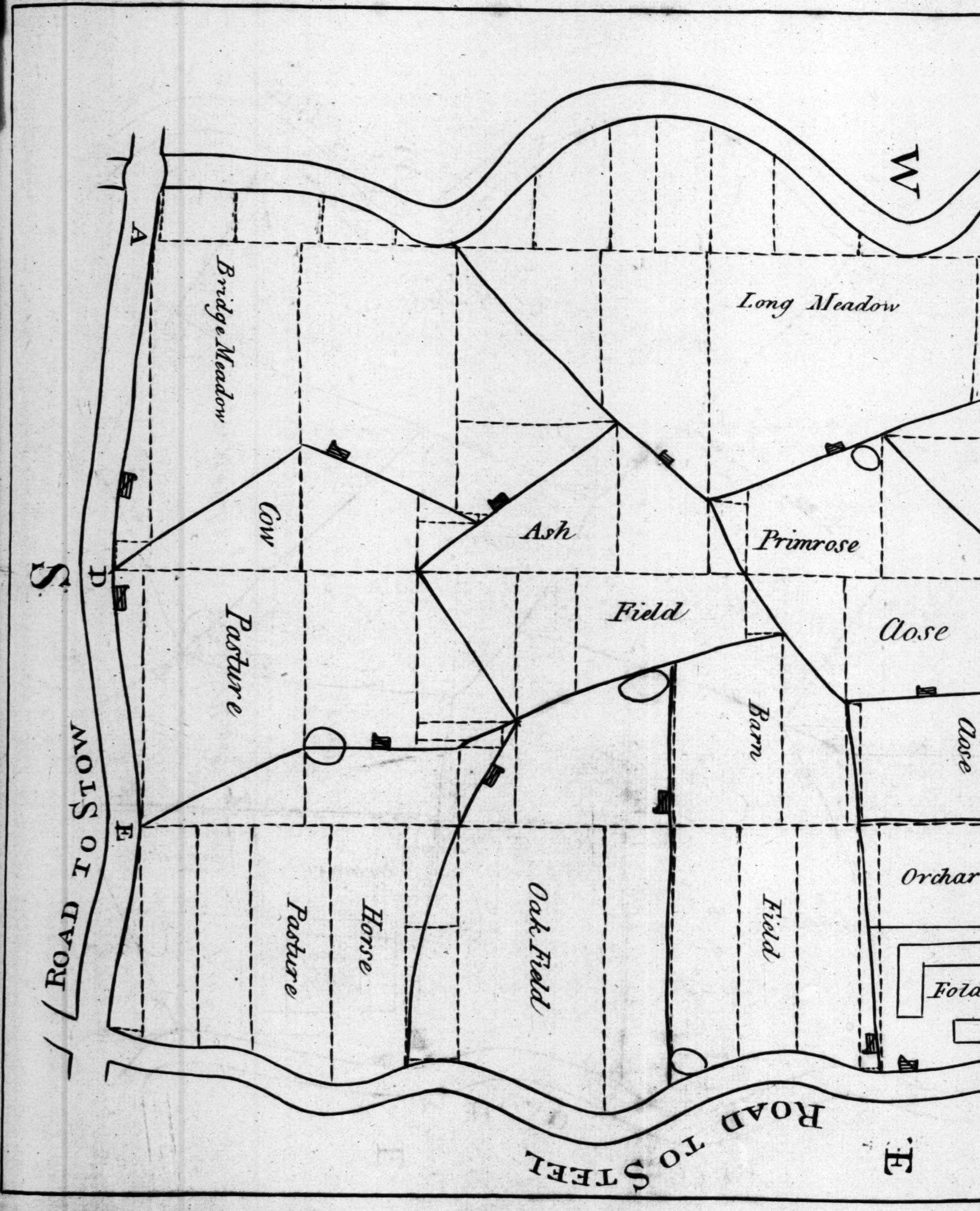
Sandy field.

R.H. off. E. -	2779¼
S. off. on do. R.H.	512½
L.H. off. W. -	421¾
	3713½

The whole collected.

	Perches		A	R	P
Bridge Meadow - - -	4528	=	28	1	8
Long Meadow - - -	6084½	=	38	0	4½
Green Meadow - - -	2177¼	=	13	2	17¼
Calves Meadow - -	2846	=	17	3	26
New Cloſe - - - -	2143¼	=	13	1	23¼
Pond Cloſe - - - -	3760¾	=	23	2	0
The Marſh - - - -	2164	=	13	2	4
Primroſe Cloſe - - -	2317¼	=	14	1	37¼
Aſh Field - - - - -	2387¾	=	14	3	27¾
Cow Paſture - - - -	3512	=	21	3	32
Horſe Paſture - - -	3435½	=	21	1	35½
Oak Field - - - -	3621	=	22	2	21
Barn Field - - - -	3042¾	=	19	0	2¾
Home Cloſe - - - -	1991¼	=	12	1	31¼
Orchard, Garden, &c. &c.	2624¾	=	16	1	24¾
Sandy Field - - - -	3713¾	=	23	0	33¾
	50349	=	314	2	29

Theſe dimenſions being caſt up, your next care will be to plan the whole, from any ſcale of equal parts, that you ſhall think proper; which, when performed, if the ſize thereof be either too large or too ſmall for the intended map (for which directions ſhall be given hereafter) to enlarge or diminiſh the ſame to any ſize. The ſmall compaſs of this treatiſe induces me to make choice of an half quarter inch ſcale, i. e. 32 Statute poles to an inch, to plan this eſtate from; but, nothwithſtanding, I would adviſe the young ſurveyor to plan the ſame from ſundry ſcales, ſuch as inch, half inch, quarter inch, &c. which will greatly edify him in the art and practice of planning; but let him ſtrictly obſerve whether his plan bears a thorough ſimilitude to plate 3; for if not, a miſtake is committed, which may readily be diſcovered by compariſon.


W
Long Meadow
Bridge Meadow
Cow Pasture
Ash Field
Primrose Close
Barn Close
Orchar
Fol
Horse Pasture
Oak Field
Field
A
D
E
S
ROAD TO STOW
ROAD TO STEEL
E

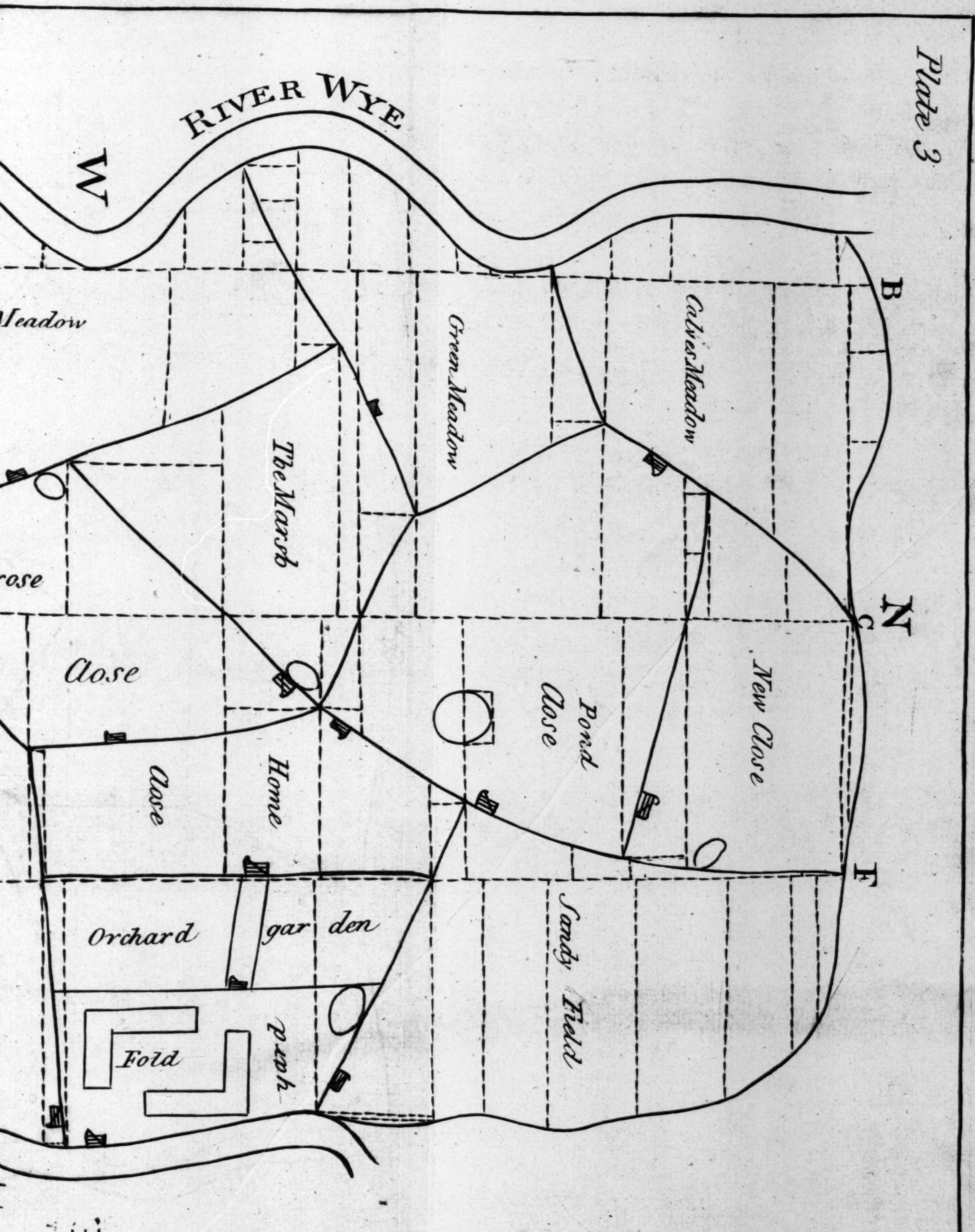


Plate 3

River Wye
W
Meadow
Green Meadow
Calves Meadow
The Marsh
rose
Close
Pond Close
New Close
Home Close
Close
Orchard
garden
Sandy Field
Fold
B
C
N
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CHAP. VI.

Teacheth how to plan (dimenſions taken by the chain only) all manner of regular and irregular incloſures, whether bounded by curved or circular hedges; likewiſe, a manor, lordſhip, or any quantity of land, containing any number of incloſures contiguous to one another; and, if required, a correct plan delineated from the dimenſions, whereby a map, decorated with peculiar ornamental embelliſhments, may be obtained. See plate the 5th, which is a map of the eſtate taken from the plan of plate the 4th.

YOU muſt take up your dimenſions, as hath been already taught in the foregoing chapters, and caſt up the contents, as before directed, by the pen; and though you have dimenſions planned, you muſt not (as thouſands have done heretofore) caſt up from the plan, it being impoſſible to tell the links under ten, upon any ſcale, exactly; and of conſequence your work would be ſubject to error, which your pen is no ways liable to, when your dimenſions are accurately taken, and the productions of your working the ſame, proved as you proceed; you may, with the greateſt certainty, rely on your return of the ſame.

Now, when your dimenſions are taken and caſt up, the next thing to be done, is to lay down the ſame upon paper, for which purpoſe the ſcale is very neceſſary. There are ſeveral different ſorts of ſcales (with regard to ſize), viz. ſcales of equal parts, containing 1, 2, 3, 4; or 10, 20, 30, and 40, chains to an inch; and theſe are decimally reduced to any other ſize, according as the meaſurer hath occaſion to uſe them.

Directions to uſe the ſcales of equal parts.

The ſcales of equal parts are for meaſuring or laying down lines, and are differently made and divided, if the 1, 2, &c. be accounted no more, the ſubdiviſions at the end and top are one, decimally divided into tens and hundreds.

But if the 1 be reckoned 10, the 2, 20, &c. whether upon the inch, half inch, or quarter inch, the ſubdiviſions are chains, and tenths of a chain; that is ten links; and when you call the 1 or 2, and 100 or 200, &c. the ſubdiviſions at the top repreſent ten chains each, and thoſe at the end one chain; for inſtance, if it were required to take 430 chains of the ſcale, ſet one foot of the dividers in 4, (whether inch, half inch, or quarter inch, it is not material, ſo that it be the ſcale you propoſe to plot by), and the other foot in the third diviſion at the top, and that extent will contain 430, which is the ſame diſtance that repreſents either 4 chains 30 links, or 43 chains.

But here every large diviſion, when the numbers 1, 2, 3, &c. are placed, are accounted 100, viz. 1 is 100, 2 is 200, &c. and then every ſmall diviſion at the top is 10, and each one at the end repreſents 1 chain only; and in this caſe, if there be any odd links, you muſt compute them between the ſubdiviſions; as ſuppoſe you muſt ſet off 64 chains 46 links, ſet one foot in 6, and extend the other to the four firſt ſmall diviſions at the top, as if you were to ſet off 64, and that repreſents 64.00, or 64 chains; then ſhift both legs of the dividers about 5 diviſions at the end, that is, between 4 and 5; the 4 repreſents 40 links, ſo that you muſt compute as near as you can the 6 odd links between the fourth and fifth diviſion; and from 6 to that place is the extent 64 chains 46 links required.

Thus having explained the ſcale, it follows next to apply it to uſe, being provided with a pair of dividers, whoſe legs are of equal length and points very fine.

EXAMPLE.

Any line or diſtance meaſured by the chain, how to lay down the ſame upon paper.

Let us then ſuppoſe the line AB to repreſent a field ſide, which, being chained, is found to contain 44 chains 25 links.

Now, to lay this down from the inch, half inch, or quarter inch ſcale, ſo that the ſame may be laid down upon paper almoſt to any ſize, it may be performed as follows:

With the dividers and ſcale, draw a right line at pleaſure; then fix one foot of your dividers at the figure 4 in the ſcale that beſt ſuits you intended ſize; but if the inch be too ſmall, you may double or treble, &c. your chains and links in each line you lay down, and take the ſame of the inch; and if the quarter inch ſcale be too large, inſtead of multiplying, you muſt divide by 2 or 3, &c. and ſo of any other ſcale. But to proceed; ſuppoſe the above is required to be laid down from the half quarter inch ſcale, and let the 1 repreſent 10, the 2.20, &c. then fixing one foot of the dividers at the point 4 for 40 chains, extend the other foot to four of the ſmall diviſions at the top (which will repreſent the four odd chains), and for the 25 links ſhift down two diviſions and a half, which are marked at the end with 2, 4, 6, 8, then you will have the whole extent of 44 chains 25 links, to wit, the ſpace from four of the long diviſions on the half quarter inch ſcale unto four of the ſmaller, comprehending both, ſhifting in a right line for 25 links, two and a half of the parallel lines from the left hand to the right at the end, you have the extent ſought.

PROBLEM I.

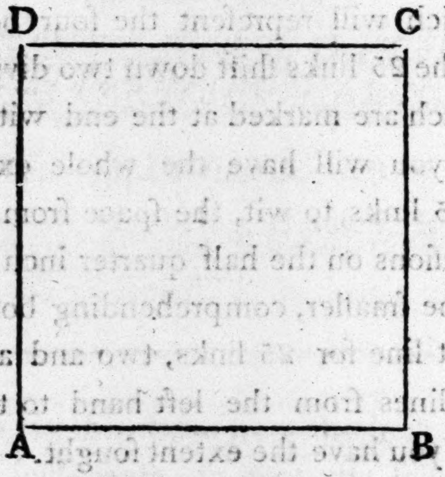
Teacheth to protract or plan upon paper a field in the form of a geometrical ſquare.

EXAMPLE.

It is required to plan the following dimenſions, brought from chap. 2, prob. 1, from a ſcale of 8 chains, or 32 poles to an inch.

DIMENSIONS.

	C.	L.
0 ———	14	20
14.20 ———	14	20



PROTRACTION.

Firſt. Take up in your dividers the firſt perpendicular, viz. 14 chains 20 links, from off a half quarter inch ſcale, and lay it from A to B, according to the directions given in chap. 2, prob. 1.

Secondly. At the point B erect a perpendicular BC, and proceed here as you were taught in prob. 7 of practical geometry (a repetition thereof in this place is needleſs), and the ſquare will be completed.

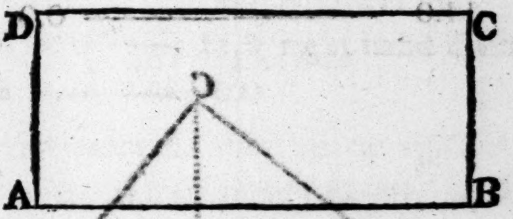
PROBLEM II.

To plot a field in the form of a rectangle, or long ſquare, from chap. 2, prob. 2.

EXAMPLE.

Let it be required to plan the annexed dimenſions from a ſcale of 8 chains, or 32 poles to an inch.

O ——————— 7.44
16.64 ——————— 7.44



Firſt. Then draw a line parallel to your breaſt with the dividers, upon which lay down 16 chains 64 links, taken from the ſcale; and then, upon the extreme points thereof, at A and B, erect perpendiculars, as you were taught in practical geometry, and lay thereon 7 chains 44 links, taken from the ſame ſcale, from A to D, and from B to C; draw a line between D and C, and you will thereby diſcover the exact form of the field that contains your dimenſions wherein they are taken.

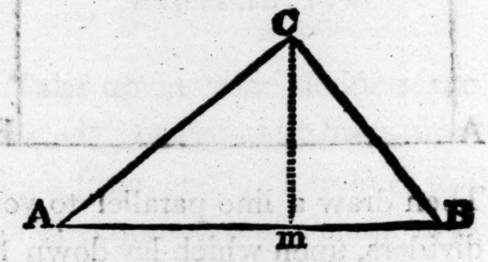
PROBLEM III.

To protract a triangle.

EXAMPLE.

It is required to plan the annexed dimenſion from a ſcale of 8 chains, or 32 poles to an inch, from chap. 2, prob. 3.

0 ——— 0.0
8.79 ——— 7.28
14.0 ——— 0.0



Draw a baſe line AB, at pleaſure, then from a ſcale of equal parts take 8 chains 79 links, and lay them down from A to m, and thereat erect the perpendicular mC, upon which lay 7 chains 28 links (taken from the ſame ſcale); from m to C take 14 chains in your dividers, and lay it down from A to B; let there be drawn two lines from A and B to the point C, by which you have completed the form of the triangle ſought, according to the above dimenſions.

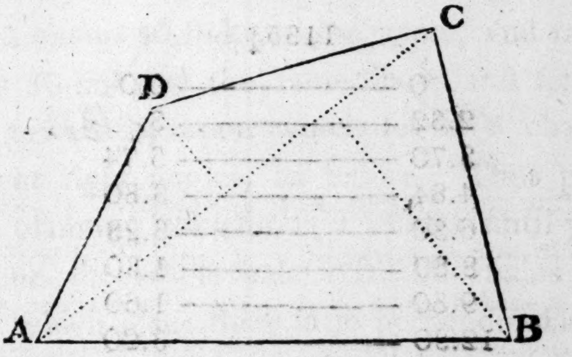
PROBLEM IV.

To protract a trapezium.

EXAMPLE.

It is required to plan the annexed dimenſions from a ſcale of 8 chains, or 32 poles to an inch, from chap. 2, prob. 4.

0 ——— 0.0
9.24 ——— 4.0 left hand perpen.
13.92 ——— 11.0 right hand ditto
18.88 ——— 0.0



The difficulty of planning the foregoing dimenſions vaniſhes when you conſider them as two diſtinct triangles, having one common baſe, commonly called the diagonal. At pleaſure draw the diagonal line AC, and make the triangle DAC; then take from your ſcale of equal parts 9 chains 24 links, and ſet it off from A towards C, and there erect a perpendicular to left hand, upon which lay down 4 chains, the firſt perpendicular found or met with in the field; from the ſame ſcale take 13 chains 92 links in your dividers, and lay it alſo from A toward C, at which place erect a perpendicular alſo, and lay thereon 11 chains, your ſecond perpendicular, and join the points A, B, C and D together, and it is done.

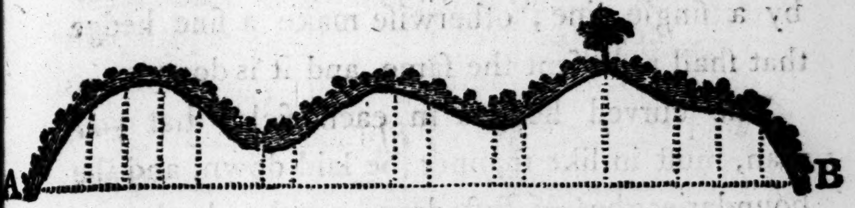
PROBLEM V.

Let it be required to plan the following dimenſions taken from Chap. 5, *Example* 1.

DIMENSIONS.

1135¾

0 ——— 0.0
2.32 ——— 3.
3.70 ——— 3.74
4.84 ——— 3.80
6.30 ——— 3.28
8.80 ——— 1.30
9.80 ——— 1.60
12.30 ——— 3.20
13.70 ——— 3.50
14.92 ——— 3.10
17.20 ——— 2
18.20 ——— 2.30
21.60 ——— 4.08
24.0 ——— 3.0
25.60 ——— 2.60
27.00 ——— 2.10
28.40 ——— 0.



CONSTRUCTION.

Draw the line AB at pleaſure, and from the ſcale of equal parts take 2 chains 32 links in your dividers, and lay it down from A toward B, and thereat erect a perpendicular, and lay thereon 3 chains; take from the ſame ſcale 3 chains 70 links, and lay it down from A toward B, and lay thereon 3 chains 74 links; take 4 chains 84 links in your dividers, and lay it down from A toward B, and erect a perpendicular thereon, and lay 3 chains 80 links on the ſame, and take 6 chains 30 links of the ſame ſcale, and ſet it from A toward B, upon which ſet off 3 chains 28 links at right angles, as before. Thus proceed in planning the aforeſaid offsets until you have done the whole baſe AB = 28 chains 40 links, at which place there is no perpendicular.

With a black lead pencil (made very ſmall or fine), draw a curve line through thoſe points in the ſeveral perpendiculars, which you may afterwards either blacken with a drawing pen by a ſingle line; otherwiſe make a fine hedge that ſhall repreſent the ſame, and it is done.

The curved hedges in each field that you plan, muſt in like manner be laid down, and the boundaries thereof firſt drawn, with a lead pencil, which may be rubbed out with a little white bread after you have drawn the ſame with ink, or made a hedge; but ſee the bread be not too new.

PROBLEM VI.

Let it be required to plan the irregular field CEFG. See Chap. V. Example 3, from the following dimenſions.

DIMENSIONS.

South offset L. H. 1ſt. ſtation. 403¾		North offset, Left Hand, 3d ſtation. 655¼	
0	0.0	0	0
0.90	1.66	1.24	1.44
2.80	1.32	5.54	0.
4.46	0.60	10.80	3.32
6.80	1.80	15.80	3.54
8.30	1.60	18.40	3.66
10.50	0.20	19.00	0
12.30	1.66		
16.0	2.34		
16.70	2.20		
17.50	0.		
19.26	0.90		
19.96	0		

Weſt offset, Left Hand, 2d ſtation.

245¾

0 ———— 0.0
1.66 ———— 1.20
4.72 ———— 0.
9.60 ———— 1.60
11.96 ———— 1.14
14.94 ———— 1.90
15.90 ———— 0.

Eaſt offsets, Left Hand, 4th ſtation.

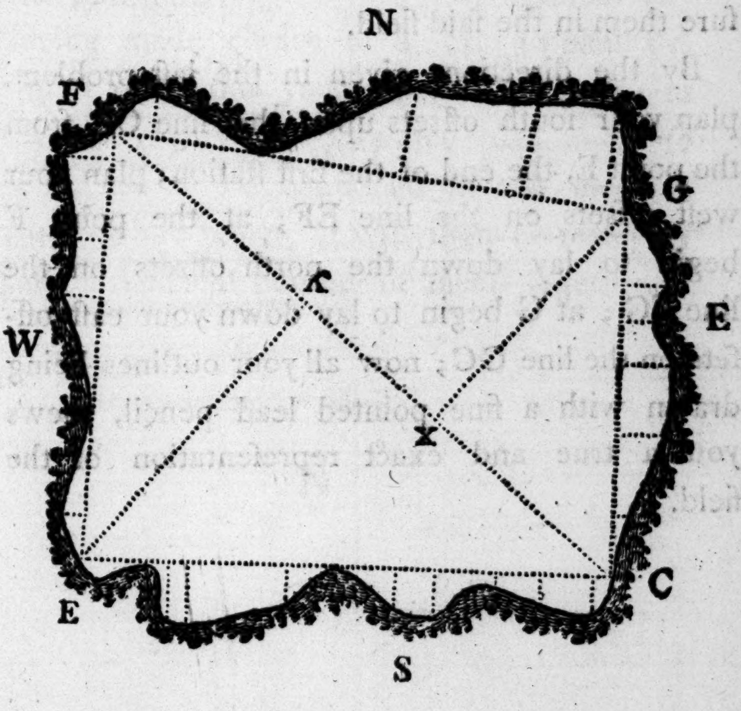
288

0 ———— 0
2.72 ———— 1.86
4.00 ———— 1.10
5.70 ———— 2.00
8.20 ———— 2.00
11.32 ———— 0.70
13.40 ———— 0

Trapezium.

4566¼

0 ———— 0
8.80 —— 10.26 R. H.
15.30 —— 12.70 L. H.
24.86 —— 0.



Firſt. Draw CF at pleaſure, then from a ſcale of 8 chains, or 32 poles to an inch, take 24 chains 86 links in your dividers, and lay it from C to F; take in your dividers 8 chains 80 links from the ſame ſcale, and lay it from C to x; at the point x erect a perpendicular towards the right hand (it being the firſt you took in meaſuring the trapezium), and lay thereon 10 chains 26 links; alſo take in 15 chains 30 links, and lay it from C to y, at which point erect a perpendicular to the left hand, upon which lay off your ſecond perpendicular, to wit, 12 chains 70 links; then from the ſeveral points CE, EF, FG, and GC, by drawing the lines CG, GF, FE, and EC, with your dividers, upon which lines, plan reſpectively the particular offsets as you meaſure them in the ſaid field.

By the directions given in the laſt problem, plan your ſouth offsets upon the line CE from the point E, the end of the firſt ſtation; plan your weſt offsets on the line EF; at the point F begin to lay down the north offsets on the line FG; at G begin to lay down your eaſt offſets on the line GC; now all your outlines being drawn with a fine pointed lead pencil, ſhews you a true and exact repreſentation of the field.

Obſerve the following direction.

You may either meaſure each field ſeparately, as already taught, and plan the ſame, or otherwiſe begin at one ſide of the eſtate, it matters not which, and draw a line quite acroſs the ſame; then meaſure each field you come into as directed in Chapter V. Example VI. by taking your dimenſions upon the right and left hand.

Until you are thoroughly maſter of planning, it is adviſeable not to meaſure more than three or four fields, till you plan your dimenſions, otherwiſe your forenoon dimenſions may be planned in the afternoon; however, when you become pretty tractable in the field, every other or third day will be ſufficient to plan your dimenſions, or field notes.

Having made choice of a ſcale to plan by, you muſt proportion your paper accordingly; to wit, if you deſign your intended plan to be ſo large as not to be contained in one ſheet of common white paper, it will then be neceſſary to paſte a ſufficient number of ſheets together.

PROBLEM VII.

Let it be required to plan the following dimenſions, from a ſcale of eight chains, or 32 *poles to an inch. See Chap.* V, *and Example* V.

Note.—Each field was meaſured ſeparate.

DIMENSIONS.

Field A.

N. off. L. H.

144¼

0	0
2.00	0.95
5.64	1.30
7.30	0.96
11.66	0.

S. off. L. H. Fd. A.
— Fd. D.

291¾

0	0
6.28	1.40
7.60	1.60
10.80	1.70
13.50	1.30
17.40	0.

E. off. L.H. Fd. A.
— Fd. B.

2080

0	0
3.60	0.80
6.80	1.94
10.90	1.00
13.20	0.

W. off. L.H. Fd. A.

249¾

0	0
7.00	2.00
12.72	0.82
14.26	0.

Field B.

R.H off. S.

— Fd. C.

160¼

0	0
3.24	0.90
6.50	1.30
9.00	0.90
13.08	0.

R.H off. E. Fd. B.

153½

0	0
4.24	1.60
7.60	1.20
10.60	0.
12.0	0.60
14.40	0.

Field C.

E. off. L. H.

254

0	0
2.66	1.70
5.66	2.20
7.40	1.80
9.60	1.20
12.00	0

Trapezium CDxG.

3078

0		0
8.30	R. H.	11.78
9.74	L. H.	6.20
21.40		0

R.H. off. N. Fd. B.

197

0	0
3.60	1.30
6.40	0.60
8.90	0.
13.0	1.84
15.60	1.06
16.40	0.

Trapezium DTax.

2660

0		0
12.18	R. H.	5.14
13.30	L. H.	8.60
24.20		0.

W. off. L.H. Fd. C.

— Fd. D.

347¼

0	0
2.20	0
2.80	0.40
4.00	0.80
6.20	2.40
8.20	3.40
10.60	2.40
14.08	0.0

S. off. L.H. Fd. C,

189½

0		0
3.20		1.20
6.20		1.80
8.80		1.00
11.98		0

Field D.

S. Offset, L. H.

303¾

0		0
6.40		0.55
7.20		1.00
9.60		1.60
12.88		1.50
15.60		0.80
16.30		0

Trapezium x b F a.

2446

0		0
10.80	L. H.	7.50
11.52	R. H.	7.70
20.12		0.

W. off. L.H. Fd. D.

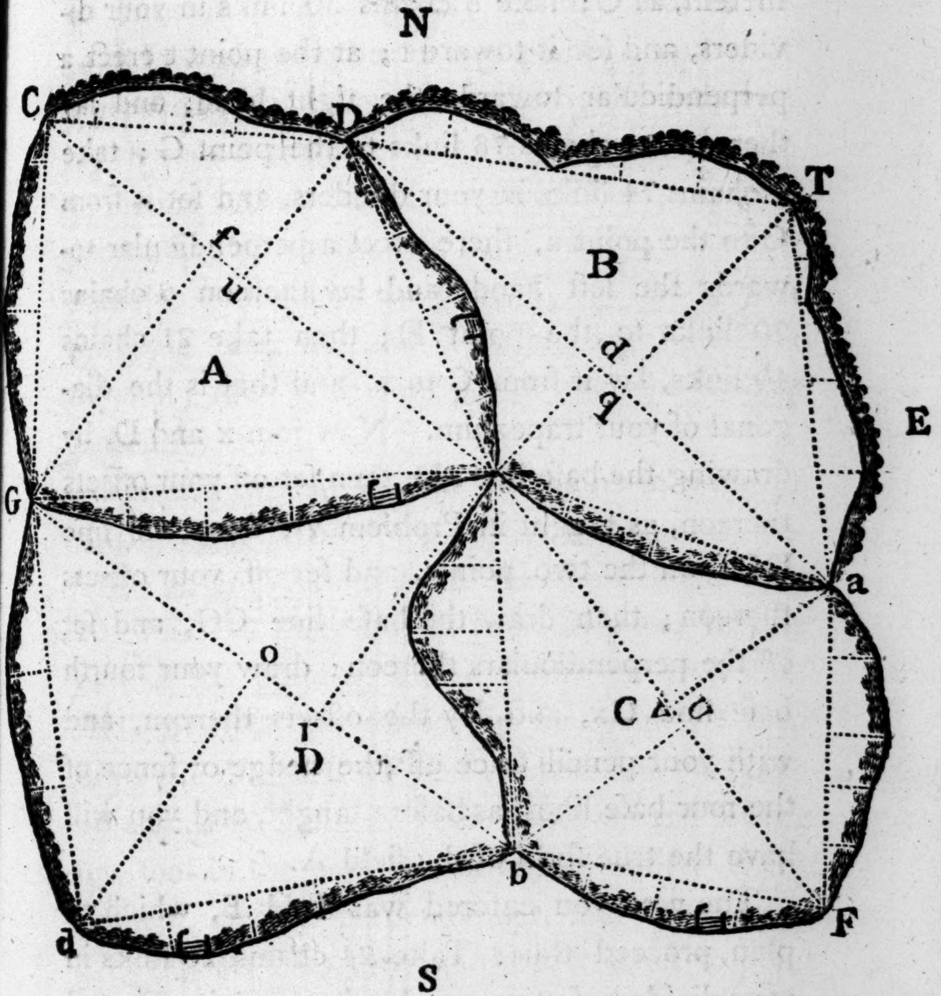
318¼

0		0
1.40		0.80
5.20		1.60
9.48		2.14
14.60		0.40
15.80		0.

Trapezium G d b x.

4084¾

0		0
11.00	R. H.	11.80
13.80	L. H.	11.20
24.20		0.



The field wherein you firſt began is called the field A, which you muſt lay down (from a ſcale of 8 chains, or 32 poles to an inch) upon paper as you took it up. Draw a line with your dividers of a ſufficient length, then aſſume a point therein, as C; take 8 chains 30 links in your dividers, and ſet it toward t; at the point t erect a perpendicular towards the right hand, and lay thereon 11 chains 78 links to the point G; take 9 chains 74 links in your dividers, and ſet it from C to the point u, there erect a perpendicular towards the left hand, and lay thereon 6 chains 20 links to the point D; then take 21 chains 40 links, lay it from C to x, and that is the diagonal of your trapezium. Now join x and D, by drawing the baſe line xD, then ſet off your offsets thereon, as taught in Problem V; draw the line DC from the two points, and ſet off your offsets thereon; then draw the baſe line CG, and ſet off the perpendiculars thereon: draw your fourth baſe line Gx, and lay the offsets thereon, and with your pencil trace off the hedge or fence of the four baſe lines, as before taught, and you will have the true form of the field A.

The next you entered was field B, which to plan, proceed thus: Take 24 chains 20 links in your dividers, ſetting one leg in the point D, and deſcribe an arch; from the ſame ſcale take 13 chains 8 links alſo in your dividers; ſet one leg in the point x, deſcribe an arch that ſhall interſect the former in the point a; then draw the baſe line xa, and the diagonal Da: take 12 chains

40 links in your dividers; ſet one foot in the point D, and the other in the point p, and erect a perpendicular thereon, to the right hand, and lay thereon 5 chains 14 links to the point x: take 13 chains 30 links, and ſet it from D to q; erect a perpendicular to the left hand, and lay thereon 8 chains 30 links to the point T, left hand; join the baſe lines aT and TD, and lay the offsets thereon; then with your pencil trace the hedges as before.

Proceed to field C, take 12 chains in your dividers, and, ſetting one leg in the point a, deſcribe an arch; then from the ſame ſcale take 20 chains 12 links alſo in your dividers; ſet one foot in the point x, and deſcribe an arch that ſhall interſect the former in the point F; then draw the diagonal x F and the baſe line F a; take 10 chains 80 links in your dividers, and ſetting one foot in the point x, extend the other to the point v, erect a perpendicular, and lay thereon 7 chains 50 links towards the left hand to point a; take alſo 11 chains 52 links, and lay it from x to u; erect a perpendicular thereat, and lay thereon 7 chains 70 links to the point b: draw your diagonal x F, and the baſe lines F a; join the lines F b and b x, ſetting off your offsets thereon, and trace the hedges with your black lead pencil.

The next you enter into is field D: take 24 chains 20 links in your dividers; ſet one leg in the point b, and the other will reach to the point G; take 11 chains in your dividers, and ſetting one foot in the point G, the other in the point o, at which place erect a perpendicular, and ſet off 11 chains 80 links towards the right hand to point d; take 13 chains 80 links, and lay it from the G to the point r; there erect a perpendicular alſo, and lay thereon 11 chains 20 links to the point x; then draw the baſe lines bd and dG, and lay your perpendiculars thereon; alſo, with your lead pencil, draw the hedges, as before taught, and you have a true repreſentation of the eſtate.

If you would chuſe to repreſent a large incloſures in a little compaſs, you muſt uſe a ſmall ſcale, as one of 40, 60, or 80 chains to an inch; but, on the contrary, if you propoſe to expreſs every ſmall particular or incident, a large ſcale is the more ſuitable, viz. 1, 2, 4, or 10 chains to an inch, there being always more room in a large plan to expreſs remarkable things, which cannot be contained in a ſmall one.

Thus having obtained (upon paper) an accurate and particular plan of the eſtate, your next care muſt be to reduce or tranſmit the ſame to vellum, or royal imperial paper: ſome gentlemen chuſe parchment, becauſe, as I ſuppoſe, it is both durable and cheap; but let not any ſuch expect a well finiſhed map, ſince it is not in the power of man to embelliſh, draw, or write well thereon; however, it is every ſurveyor's buſineſs to conform with and obey his employer's orders in this reſpect; nevertheleſs, the ſurveyor may recommend vellum if he chuſes, which at all events can only be rejected.

Directions to plan the eſtate, from Chapter V. Example VI.

Being accommodated with a ſheet of paper, ſcale, and dividers, draw an obſcure or dry line quite acroſs the ſheet of paper, perpendicular to your breaſt, that ſhall repreſent the firſt main line in the fields; fix upon a point, as at A, and take from your ſcale 73 chains, and lay it from A to B, which points limit the firſt main line; upon the left hand ſide thereof lay down thoſe dimenſions that were taken upon that ſide in the field; the right hand ſide is appropriated to all thoſe dimenſions entered in the right hand column of the field book, which being placed before you, proceed thus:

At the beginning at A there is no perpendicular in the left hand column, but there is one in the right hand column=15 chains 10 links; at the point A erect a perpendicular to the right hand, by applying the end of the ſcale upon, and parallel to, the main line, ſetting or fixing one corner of the ſcale in the point; from thence draw a perpendicular or obſcure line, whereon lay down 15 chains 10 links, the firſt perpendicular; at the end of this is an offset upon an offset at the right hand, that is, at 15 chains 10 links, erect a perpendicular to the right hand and lay down 1 chain 70 links; at the end of that there is an offset upon that to the left hand; at 1 chain 70 links erect a perpendicular to the left hand, and lay thereon 1 chain 60 link; then from A to the points draw a pencil line; at the end of 42 links, there is 2 chains 50 links of a perpendicular to the left hand, therefore take 42 links from your ſcale, and lay it on the main line from A towards B, at which point erect a perpendicular to the left hand, and lay down 2 chains 50 links for your ſecond perpendicular, and with your pencil join this to A; then take in your dividers 4 chains 20 links, and lay it on the main line as before, at which point draw an obſcure perpendicular line on the left hand ſide, upon which lay down 4 chains 40 links, with your pencil join this to the end of the laſt perpendicular; take from the ſcale 7 chains 30 links, and lay it down from A towards B, at which point erect a perpendicular on the right hand ſide, and lay thereon 10 chains 8 links; with your pencil join this to the laſt right hand perpendicular; take 8 chains 30 links in your dividers, and lay it from A towards B; at this point erect a perpendicular on the left hand ſide, and lay thereon 2 chains 40 links, this join with your pencil; take from your ſcale 12 chains, and lay it on the main line as before, and erect a perpendicular to the left hand, and lay down 1 chain, which join as before; take 15 chains 10 links in your dividers, and lay it from A towards B; at that point there is no perpendicular on the left hand ſide, as it croſſeth the hedge in corner of long meadow, but draw a line from this point to the laſt perpendicular, which completes the river ſide in bridge meadow; at the laſt erect a perpendicular on the right hand ſide, and lay down 13 chains 40 links, and on this line firſt lay off 7 chains 80 links, and then lay 1 chain 90 links, on this laſt is an offset upon that which ſet off. Now with your pencil draw a line from the laſt perpendicular, trace to the point of the offset upon that, from thence trace the next in the corner of aſh field, and from that point to the point in the main line in corner of long meadow: now you have the fence of bridge meadow complete. Next proceed with your main line, take 18 chains 80 links in your dividers and ſet it from A towards B, at which point erect a perpendicular on the left hand ſide, and lay down 3 chains 80 links; take 22 chains from your ſcale and lay it on your main line, erect a perpendicular on the right hand ſide, and lay down 8 chains; take 22 chains 48 links in your dividers, and lay it from A towards B; erect a perpendicular on the left hand ſide, and lay thereon 6 chains 20 links; take from your ſcale 24 chains 66 links; and lay it on the main line from A toward B, at which point erect a perpendicular on the left hand ſide, and lay down 6 chains 60 links; take 27 chains 30 links in your dividers, and lay it on the main line, at which point erect a perpendicular on the right hand, and lay thereon 12 chains 40 links; with your pencil join this to the corner in bridge meadow; take 27 chains 40 links in your dividers, and lay it from A towards B, erect a perpendicular on the left hand ſide, and lay thereon 6 chains 40 links; take from your ſcale 30 chains 40 links, and lay it on the main line, at which point erect a perpendicular on the left hand ſide, and lay down 4 chains 80 links; take 34 chains 48 links, and lay it from A towards B, erect a perpendicular, and lay thereon 1 chain 20 links; take from your ſcale 37 chains 20 links, and lay it on the main line from A towards B, at which point there is no perpendicular; the main line toucheth the ſide of the river at this part on the left hand ſide: now with your black lead pencil trace the river ſide through all the perpendiculars to the point in the main line in corner of bridge meadow; take in your dividers 40 chains 20 links, and lay it on the main line from A towards B, at which point erect a perpendicular on the right hand ſide, and lay down 7 chains 4 links, with your pencil join this to the laſt right hand perpendicular; take in your dividers 40 chains 90 links, and ſet from A towards B, at which point erect a perpendicular on the left hand ſide, lay thereon 2 chains 60 links; take 43 chains 50 links in your dividers and lay it on the main line, erect a perpendicular on the left hand ſide, and lay thereon 5 chains; upon this perpendicular there is an offset upon an offset to the right hand; take in your dividers 46 chains 10 links ſet from A toward B, at which point, there is no perpendicular on the left hand ſide, for the main line croſſeth the hedge in that point, but erect one on the right hand, and lay down 4 chains 40 links; upon this there is an offſet upon an offſet left hand; from this point with your pencil join the two laſt perpendiculars; likewiſe draw a line from this point acroſs the main line to the laſt left hand perpendicular, and from that point trace the river ſide to the point left off at before: now you croſs the hedge into green meadow, where there is a perpendicular on the left hand ſide=5 chains 80 links; on this perpendicular there are two offſets upon an offſet to the left hand, theſe being drawn, take from your ſcale 48 chains 60 links, and lay it from A towards B; at this point erect a perpendicular on the left hand ſide, and lay thereon 5 chains 40 links; take in your dividers 49 chains, and lay it from A towards B, at which point erect a perpendicular on the right hand ſide, and lay thereon 4 chains 60 links; take 51 chains 20 links in your dividers, and lay it from A towards B, at which point erect a perpendicular on the left-hand ſide, and lay down thereon 3 chains 60 links; take 51 chains 70 links in your dividers, and lay it from A towards B, at which point erect a perpendicular on the right hand ſide, and lay down thereon 11 chains 30 links; with your pencil draw a line to the corner of long meadow; take in your dividers 53 chains 40 links, and lay it down on the main line, at which point erect a perpendicular on the left hand ſide, and lay thereon 1 chain 40 links; take from your ſcale 55 chains; and lay it down from A towards B, at which point erect a perpendicular, and lay down thereon 60 links; take 56 chains 25 links in your dividers, and lay it on your main line; at that point erect a perpendicular on the left hand ſide, and thereon 25 links; take from your ſcale 58 chains, and lay it down from A towards B, at which point there is no perpendicular on the left hand, for the main line croſſeth the hedge in the corner of calves meadow; from this point, with your black lead pencil, trace the river ſide through all perpendiculars to the corner of long meadow, but on the right hand erect a perpendicular, and lay thereon 7 chains 80 links; upon this perpendicular is an offset upon an offset to the left hand; draw a pencil line from this point to the river ſide for the hedge; now croſs the hedge, there is a perpendicular on the left hand ſide=80 links; take from your ſcale 60 chains 40 links, and lay it down from A towards B, at which point erect a perpendicular on the right hand ſide, and thereon 6 chains 70 links; take 60 chains 80 links in your dividers and lay it on the main line, at which point erect a perpendicular on the left hand ſide, and lay thereon 2 chains 20 links; take 63 chains 60 links in your dividers, and lay it from A towards B, at which point erect a perpendicular on the left hand ſide, and lay down thereon 3 chains; take from your ſcale 68 chains 30 links, and lay it down from A towards B, at which point erect a perpendicular on the right hand ſide, and lay down 11 chains 90 links; take in you rdividers 71 chains 30 links, and lay it down on the main line, at that point erect a perpendicular on the left hand ſide, and lay down 2 chains 80 links; from this point trace the river ſide through all the other perpendiculars to the corner of green meadow; take 71 chains 80 links in your dividers, and lay it down from A towards B, at which point erect a perpendicular on the right hand ſide, and lay down thereon 15 chains 64 links to point C; from the point at C draw a line to the corner of green meadow, which line will divide calves meadow from pond cloſe and new cloſe; on the laſt perpendicular there are two offsets upon an offset to the left hand, which plan; take from your ſcale 73 chains, and lay it down from A to B; from the point C draw a line to the point B, and from B to the laſt left hand perpendicular. Now you have completely planned the firſt main line, the next thing is to plan your ſecond main line: draw a line from the point C to the point D, and lay down thereon 73 chains 64 links; then begin at the point C and lay down the right and left hand perpendiculars, till you come to the point D; likewiſe be careful to draw the hedges of each field exact, and mind that you enter every pond, pit, gate, &c. in each field: now proceed to the third main line; draw a line from the point E to the point F, and lay 72 chains thereon; then begin at the point E, and lay down your left and right hand perpendiculars, till you arrive at the point F, drawing the hedges, ponds, pits, &c. in each field, as before taught; alſo lay down the ground, plan of the houſe, buildings, &c. All difficulty of planning from main lines depends upon drawing them exactly true in their proper place: theſe done, the work will then be found to be exceeding eaſy.

With pen and ink draw or trace off all the pencilled lines in the plan, then is the ſame ready to be transferred to a map or vellum, or whatever elſe is intended for that purpoſe, which to perform, obſerve the following

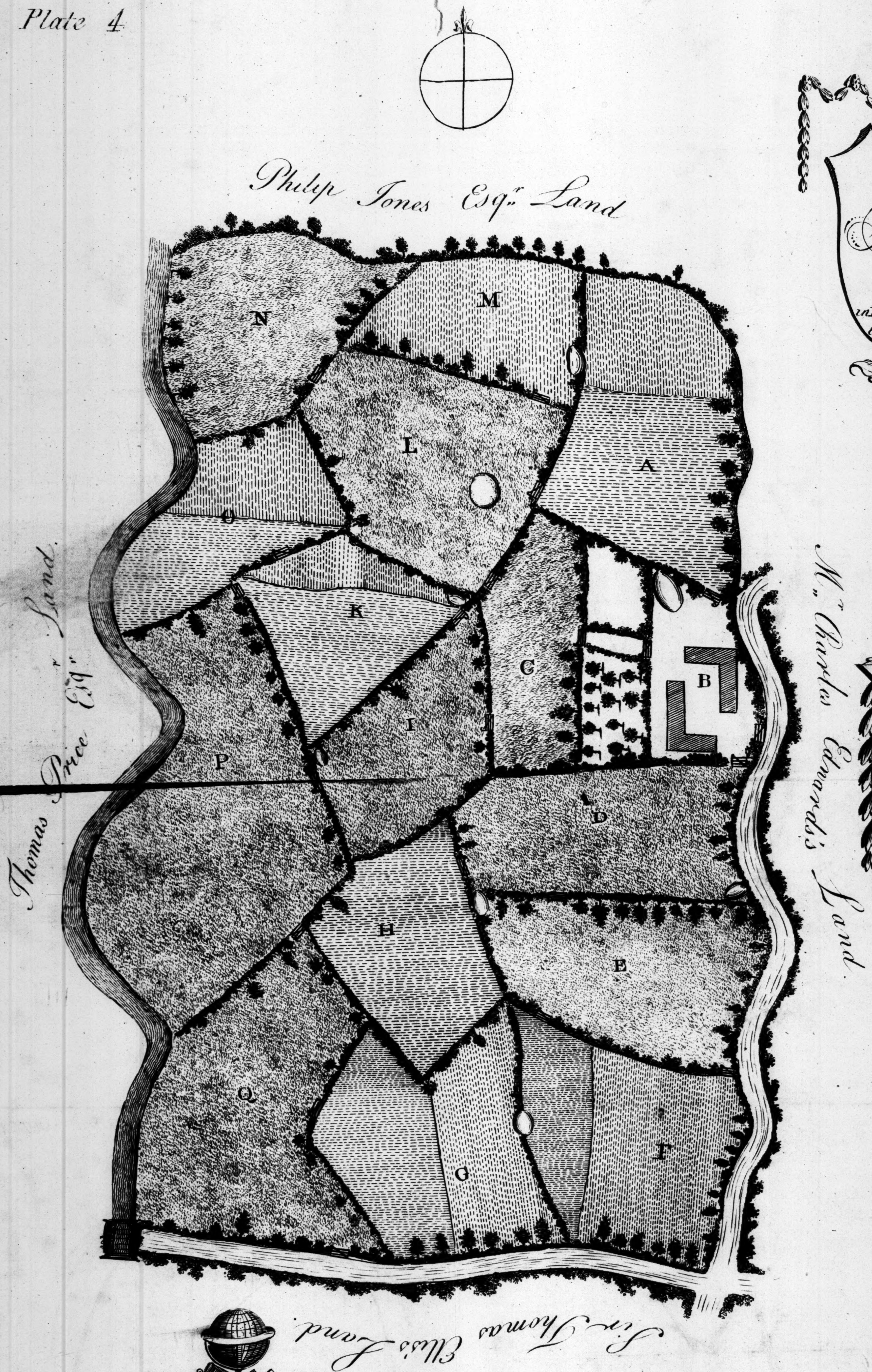
DIRECTIONS,

To transfer or trace off upon vellum, parchment, or paper, the plan of an eſtate, and afterwards embelliſh the ſame.

The ſize of your vellum, parchment, or paper, being adapted to the plan, whereon if greaſe or any thing elſe hinder the pen to ſlide freely, a little pounce rubbed thereon occaſionally, will greatly help the ſame, alſo prevent the ink from ſpreading. Lay your plan carefully upon the vellum, parchment, or whatever elſe you intend to draw your map upon, then three or four ſmall nails being ſtuck into the table through the plan and corners of the vellum, &c. to prevent the ſame from ſhifting or moving (though weights, or books, with care, anſwer the ſame purpoſe); then with the point of your dividers trace off all the lines on the plan, preſſing the ſame gently, ſo that the impreſſion may appear on the vellum, &c.; thus having traced over all the lines exactly, take up the plan, and you will ſee underneath all thoſe lines upon the vellum, &c. that are in the plan, and then with a fine pen and good Indian ink, make thereon hedges,

&c. ſuch as appear in the following Map. When the hedges, &c. belonging to each and every field, are finiſhed, it will be a great addition to the beauty of the Map, to adorn the hedges on one ſide with proper ſhadings or colours to repreſent the ditches; and the paſture or meadowing being touched up with a tranſparent green colour, in imitation of graſs (but not daubed on); arable or ploughed land with a brown earthen colour, &c. laid on in ſuch a manner as will render the ſame all through a ſimilitude of ridges and furrows. There are many gentlemen that chooſe to have a Map of their eſtates ornamented with colours; but, in my humble opinion, good Indian ink is much preferable thereto; however, it greatly behoves every ſurveyor to pleaſe, if poſſible, his employer, and therefore I ſhould think it adviſeable for thoſe who are ſo employed, to have a ſmall ſpecimen of their performance upon vellum, curiouſly ornamented, to ſhew their employers, wherein ſhould appear ſome ſmall cloſes finiſhed with Indian ink, and ſome with colours. Having completed the fields, &c. in the Map, make choice of a compartment, or vacancy therein, at the top, if poſſible, to draw the coat of arms belonging to the gentleman that owns the eſtate, with ſhield, creſt, and ſupporters; the ſhield ſhould be drawn ſo, that it may contain the title, townſhip and county, or any thing elſe that is proper to denote the ſituation thereof. The art of drawing ſuch ornaments will ſoon be obtained by aſſiduous application, and ſome inſtructions therein from a limner. In another compartment or vacancy, draw the dividers, pen, the ſcale you laid down the Map by, &c.; draw the mariner's compaſs, with the flower-de-luce therein, pointing to the north exactly. However, for the young learner's farther improvement herein, here follows a Map of the eſtate mentioned in the foregoing example, properly embelliſhed, wherein is repreſented paſture, meadowing, ploughed land, and whatever elſe that is neceſſary, which will undoubtedly edify more, than if ſeveral pages were wrote upon the occaſion. Now, if the whole be well performed, the Map will be a neat ornament to hang up in the owner's ſtudy, or whereever elſe he ſhall chooſe, ſo that at pleaſure he may ſee his whole eſtate in his chamber, and likewiſe the particular quantity of each and every incloſure therein, without any manner of trouble, but rather a pleaſure. Thus having briefly and particularly taught and directed how

Plate 4



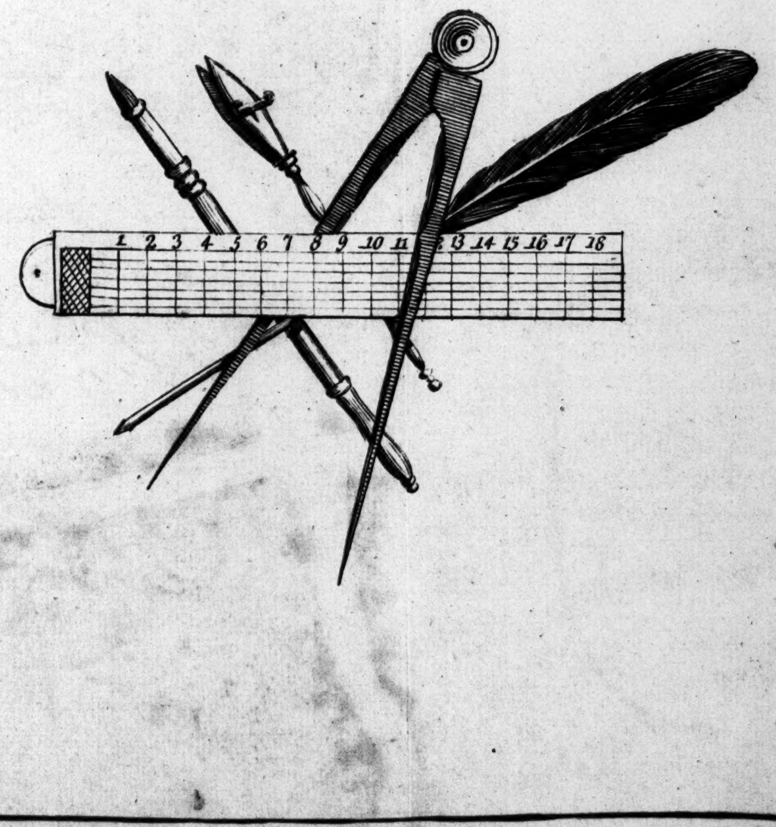
MAP and Survey of an ESTATE

inT—r in the County of E—x
belonging to Wm. P—r Esqr.

REMARKS.

559 Oak Trees containing 22 452 Feet
77 Ash Trees containing 2540 Feet
52 Elm Trees containing 1600 Feet
43 Poplar Trees containing 860 Feet
35 Willow Trees containing 700 Feet
14 Fir Trees containing 1000 Feet
7 Walnut Trees & 12 Apple Trees
The Land for the most part is Dry & Good
June 12th.
1798

	PREMISES	Quantity			
A	Sandy Field	23	0	83	1/4
B	House Garden &c.	16	1	24	3/4
C	Home Close	12	1	31	1/4
D	Barn Field	19		2	3/4
E	Oak Field	22	2	21	
F	Horse Pasture	21	1	35	1/2
G	Cow Pasture	21	3	32	
H	Ash Field	14	3	27	3/4
I	Primrose Close	14	1	37	1/4
K	The Marsh	13	2	4	
L	Pond Close	23	2		
M	New Close	13	1	23	1/4
N	Calves Meadow	17	3	26	
O	Green Meadow	13	2	17	1/4
P	Long Meadow	38		4	1/4
Q	Bridge Meadow	28	1	8	
	Total Acres	314,229			



Wm. Davis delint.

T. Prattent Sculpt.

an eſtate (conſiſting of any number of incloſures) may be ſurveyed by the chain, and alſo how the ſame may be accurately planned and Mapped, I come, in the next place, to ſhew how a pond, pool, mere, wood, or any inacceſſible ground may be meaſured.

How to meaſure a mere, or pool of water.

RULE.

From the area that the rectangular lines include, deduct the area of the ſeveral inſets that are between thoſe lines, the mere, or pool, &c.; the remainder will be the true area ſought.

EXAMPLE.

Admit fig. 1, *plate* 5, *to repreſent a mere of water, and it be required to know the true content thereof.*

DIRECTIONS.

Set up your croſs ſtaff at or in the corner A, and there fix upon two places, or marks (to wit, at B and D), at right angles to each other; meaſure the line AD, and take up the left hand inſets thereon, which being entered, return to your croſs ſtaff at the mark A; but forget not to leave a mark at D; then chain the line AB, upon which take up the inſets on the right hand thereof: fix your croſs ſtaff in B, which will direct you to chain another line at right angles to the laſt meaſured line, to wit, BC, and take up the inſets upon this alſo on the right hand ſide. Now chain from C to the mark left at D, and take up the inſet thereon, and it is done; thereby you have obtained the following dimenſions:

DIMENSIONS.

S. inſets, L.H. taken upon the line AD.

632¾

0 ——— 0
0.62 ——— 0.60
4.60 ——— 2.0
8.00 ——— 1.80
13.00 ——— 1.70
18.00 ——— 3.40
21.20 ——— 0.
22.19 ——— 0.40
22.80 ——— 0.

W. inſets, R. H. taken upon the line AB.

702¼

0 ——— 0.
0.70 ——— 0.66
1.20 ——— 0.
4.80 ——— 1.90
8.70 ——— 2.68
13.00 ——— 1.80
15.68 ——— 2.80
26.68 ——— 0.

E. inſets, R.H. taken upon the line CD.

599¾

0 ——— 0
1.40 ——— 0
10.40 ——— 1.20
14.20 ——— 4.0
16.30 ——— 3.28
19.80 ——— 1.00
21.40 ——— 2.40
26.0 ——— 0.
26.50 ——— 0.40
26.80 ——— 0.

Figure ABCD.

9690

0 ——— 22.80
26.68 ——— 22.60

N. inſets, R.H. taken upon the line BC.

982½

0	0
5.90	1.20
9.06	3.80
12.20	4.24
16.10	3.40
21.40	1.90
22.60	0.

The ſeveral inſets upon the lines

AD	623¾
AB	702¼
AC	982½
CD	599¾
	2908¼

The area of the figure ABCD 9690

Take from ABCD 2908¼

The area in poles 6781¾

The true area in acres	A	R	P
	43	0	1¾

The content of the mere

Directions to plan the aforeſaid dimenſions of the mere.

Draw the line AB at pleaſure; at the point A erect a perpendicular on the line AB to the point D, and lay on 22 chains 80 links. Next lay all the ſouth inſets thereon; then from the point D trace the water's edge through all the inſets to the point A; ſo you will have the ſouth ſide of the mere planned. Take 26 chains 68 links, and lay it down from A to B, and lay thereon all the weſt inſets; then trace the water's ſide through all the inſets to the point B; at the point B erect a perpendicular, and lay thereon 22 chains 60 links to the point C; then lay down all the inſets thereon, and trace the water's ſide through all the inſets. Next draw the line CD, and lay down the inſets thereon; trace the water's ſide through all the inſets, and then you will have the true plan of the mere: in like manner are all woods planned.

Directions to the young ſurveyor aſcending and deſcending hilly ground.

When a hill interpoſes in the ſurvey, in chaining over the ſame, you may find both the arch and alſo the chord line, i. e. the hill's foundation, thus: If the hill be not very ſteep, let your foreman, at the end of every aſcending chain, ſtick down his arrow, keeping the chain end cloſe to the ground, whilſt you hold up the chain at full ſtretch, breaſt high, or higher, until it be parallel to the horizon, to wit, at right angles to a ſuppoſed line between your chain-hand ſo poiſed and the arrow formerly ſtuck down, the chain end being held exactly over the ſame. In this manner proceed until you ſurmount the hill, by which means you will have the foundation line of the hill, as far as you thus advance thereon; and, as you aſcend, you may alſo meaſure the ſlant thereof, which will enable you to find the ſuperficial area and altitude of the ſame, if required. In deſcending a hill, you muſt perform the part of your foreman, when aſcending, whilſt he raiſes his chain hand, &c. as you did before. But if the hill be very ſteep, your beſt way then will be to meaſure up and down the ſame by half or quarter chains, which, with care, will more effectually anſwer your end, than all the inſtruments ever conſtructed for the like occaſion.

CHAP. VII.

To reduce a large plan into a leſſer compaſs, according to any given proportion; and, on the contrary, how to enlarge one.

SUPPOSE ABCDE, fig. 2, plate 5, be laid down by a ſcale of 2 chains to an inch, it is required to reduce the ſame to 5 chains to an inch.

Firſt. Draw the line xt, and lay thereon 8 chains; then divide the ſame into eight equal parts; at each diviſion erect a perpendicular; take 8 chains in your dividers, ſet one foot in the point x and the other to the point v; divide the line xv into eight equal parts: alſo erect a perpendicular at each point; the perpendiculars on the line xv croſs the perpendiculars on the line xt, which divideth the ſquare xvwt into ſixty-four complete ſquares. Now, to reduce this plan to a ſcale of 5 chains to an inch (fig. 3 plate 5.) draw the line Fn, and take from a ſcale of 5 chains to an inch 8 chains, and lay it down from F to n; divide the ſame into eight equal parts, erecting perpendiculars at each diviſion: take 8 chains from the ſame ſcale, and lay it down from from F to o, which divide into eight equal parts; likewiſe erect a perpendicular at each diviſion: theſe perpendiculars croſs each other the ſame as fig. 2. Now, F o m n being divided into 64 ſmall ſquares, this is completed by drawing every line or incident that appears in each ſquare of the firſt plan, in the ſame ſquare of the ſmaller plan: the ſituation of the lines, &c. with regard to the correſponding ones in each plan, will direct you to proceed, by imitating, in the leſſer, every line, turn, and incident that appears in the greater. But if the plan be too ſmall, as if you were to enlarge the figure PRST, in that caſe proceed as before directed, by imitating all the ſame incidents and lines in the large plan that are in the leſſer. Many other methods of reducing plans might here be given; but they rather ſerve to amuſe than edify. For to have one method well in this caſe will be ſufficient for any practitioner.

To turn or change one meaſure into another.

RULE.

To reduce ſtatute to cuſtomary meaſure.

Multiply the number of acres, roods, and poles ſtatute meaſure, by the ſquare half yards in a ſquare pole ſtatute meaſure, and divide the product by the ſquare half yards in a ſquare pole cuſtomary meaſure, and the quotient is the anſwer in ſquare poles.

To reduce cuſtomary to ſtatute meaſure.

RULE

Multiply the number of acres, roods, and poles cuſtomary meaſure, by the half ſquare yards in a ſquare pole cuſtomary meaſure, and divide the product by the ſquare half yards in a ſquare pole ſtatute meaſure, and the quotient is the anſwer in ſquare poles.

EXAMPLE I.

It is required to reduce 9 acres, 2 roods and 19 poles ſtatute meaſure, of 5 yards and a half to the pole, to cuſtomary meaſure, of 6 yards to the pole.

```
        A   R   P
        9   2   19
        4
       ——
       38        12 } ½ yards in a pole cuſtomary
       40        12 }
     ————      ———
     1539       144 ſquare
      121
     ————
     1539
    3078
   1539
  ——————  160 A   R   P
144)186219(1293(8   0   13, anſwer
    144     1280
   ————
    422           11 } ½ yards in a ſtatute pole
    288           11 }
   ————          ———
    1341          121 ſquare
    1296
   —————
      459
      432
     ————
      27 remains
```

EXAMPLE II.

Reduce 8 acres and 13 poles cuſtomary meaſure, of 6 yards to a pole, to ſtatute meaſure of 5 yards and a half to the pole.

```
             A    R    P
             8    0   13
             4
            ——
            32
            40
          ————
          1293
           144
          ————
          5172
         5172
        1293
        ——————
        186192
            27 remains from laſt example
        ——————   160   A    R    P
   121)186219(15391(9     2    19 anſwer
       121       1440
       ———       ————
        652    40)99(2
        605        80
        ———        ——
        471        19
        963
        ———
       1089
       1089
       ————
```

EXAMPLE III.

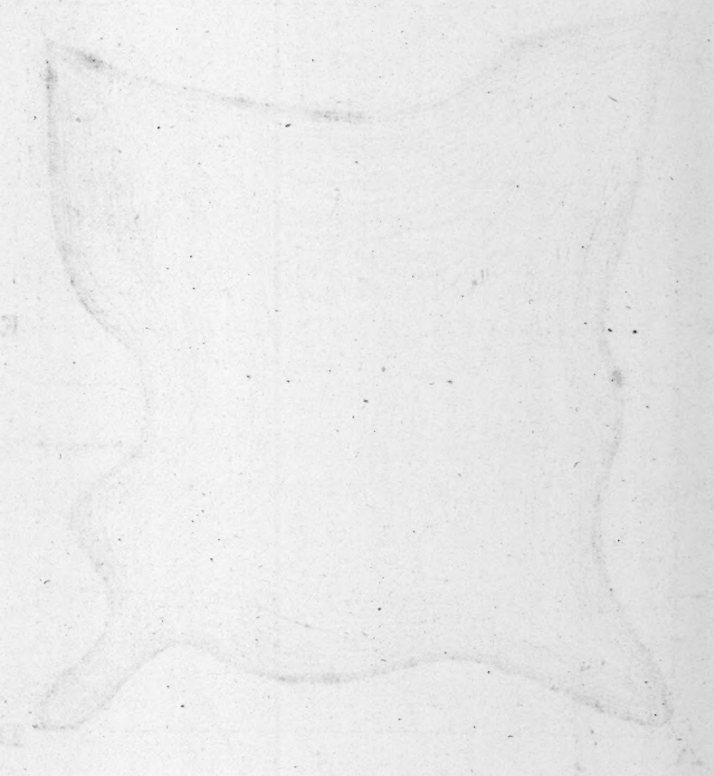
Let 314 acres 2 roods, Cheſhire meaſure, of 8 yards to the pole, be reduced to ſtatute meaſure of 5 yards and a half to the pole.

```
           A    R
         314    2
           4
       ------       16 }
        1258        16 } ½ yards in a pole Cheſhire
          40       ---
       ------      256 ſquare
       50320
         256
     --------
      301920
     251600
    100640
   ---------- 160     A    R   P
121)12881920(106462(665   1   22 anſwer
    121        960
    ---        ---
     781       1046
     726        960
     ---        ---
      559       862
      484       800
      ---       ---
       752   40)62(1
       726      40
       ---      --
        260     22
        242
        ---
         18
```

EXAMPLE IV.

Reduce 665 acres, 1 rood, and 22 poles ſtatute meaſure, to Cheſhire meaſure of 8 yards to the pole.

```
          A   R   P
         665  1   22
           4
        -----
        2661
          40
       -------
      106462
         121
       -------
      106462
     212924
    106462
    --------
    12881902
          18 remainder from laſt example
    --------  160     A   R
256)12881920(50320(314  2 anſwer
    1280      480
    ----      ---
      819     232
      768     160
      ---     ---
       512     720
       512     640
       ---     ---
         0   40)80(2
                80
```



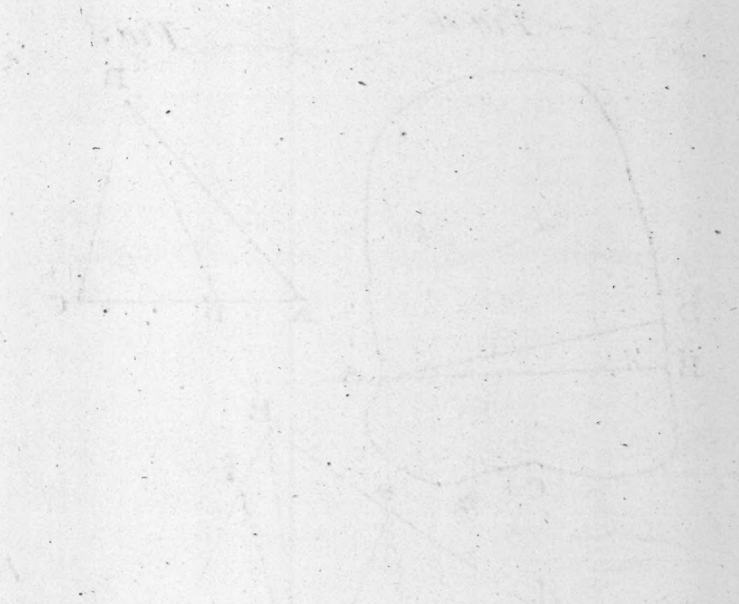
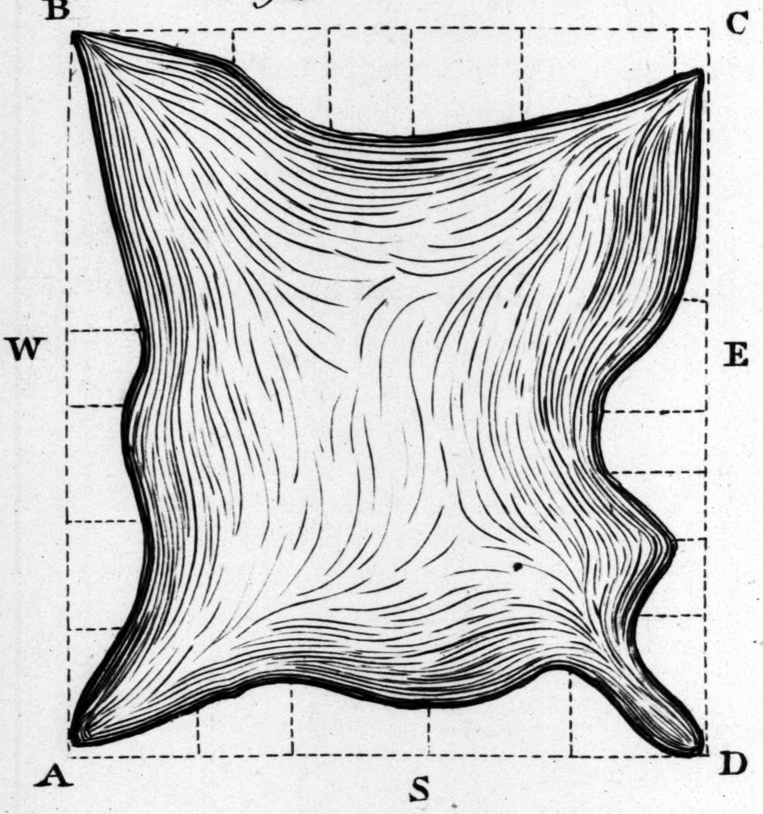


Fig.1



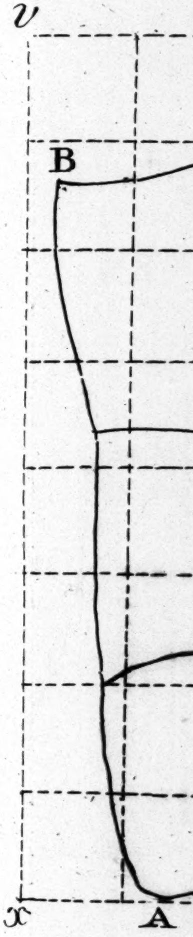


Fig 4

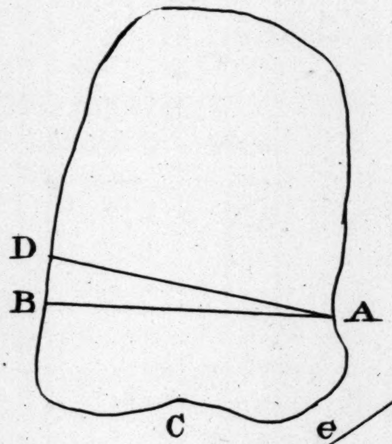


Fig 5

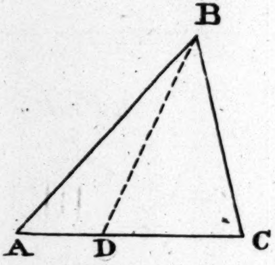


Fig 6

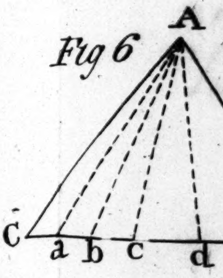


Fig 7

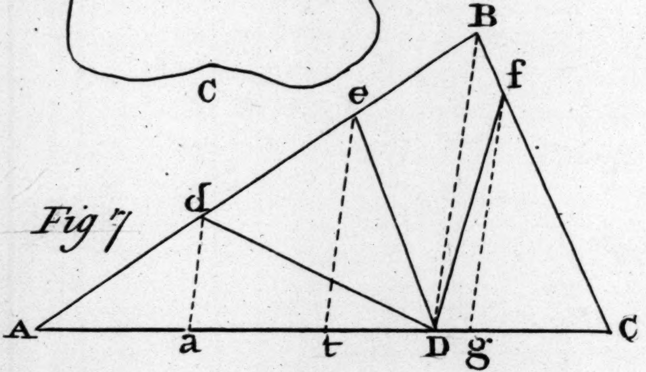


Fig 8

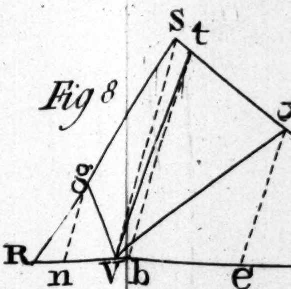


Fig 2

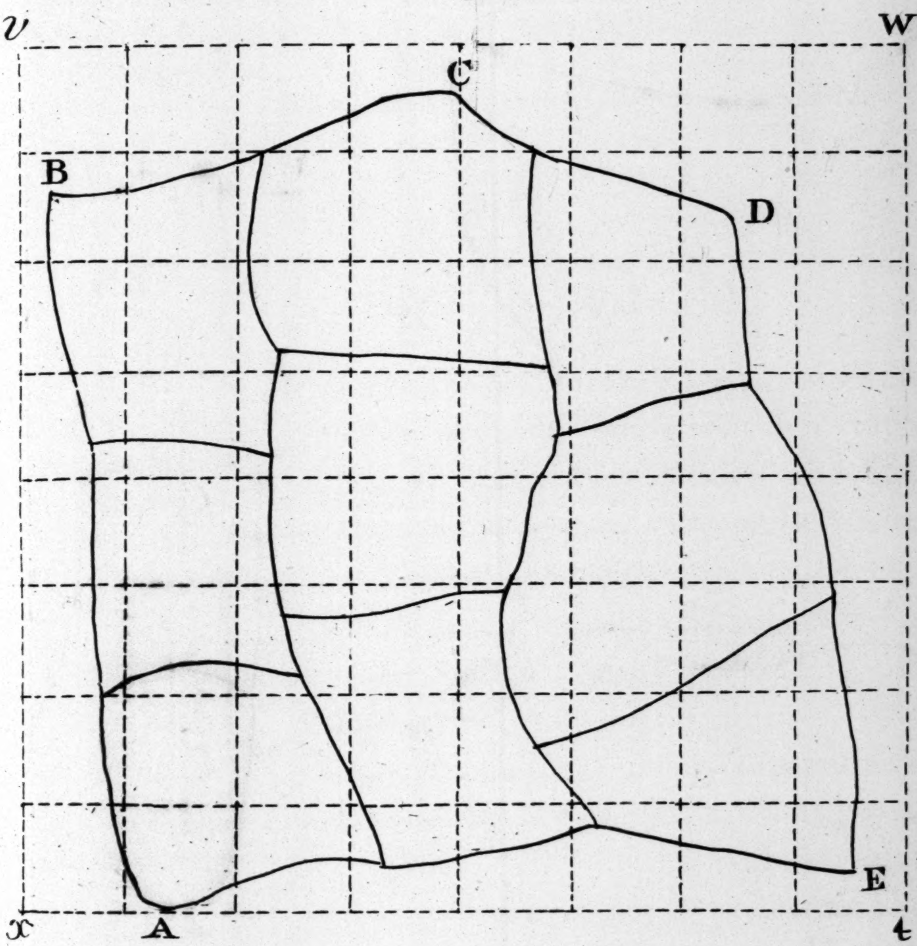


Fig 3

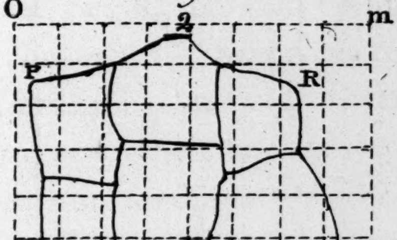
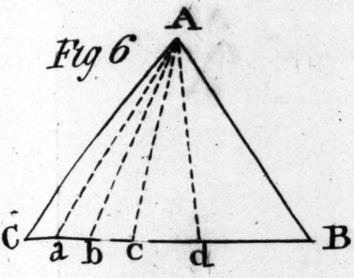


Fig 6



ig 8

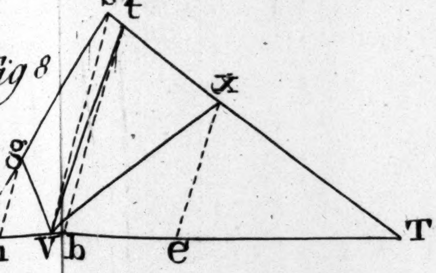
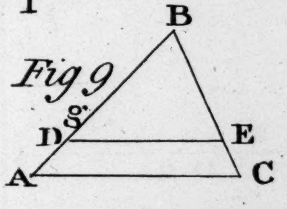
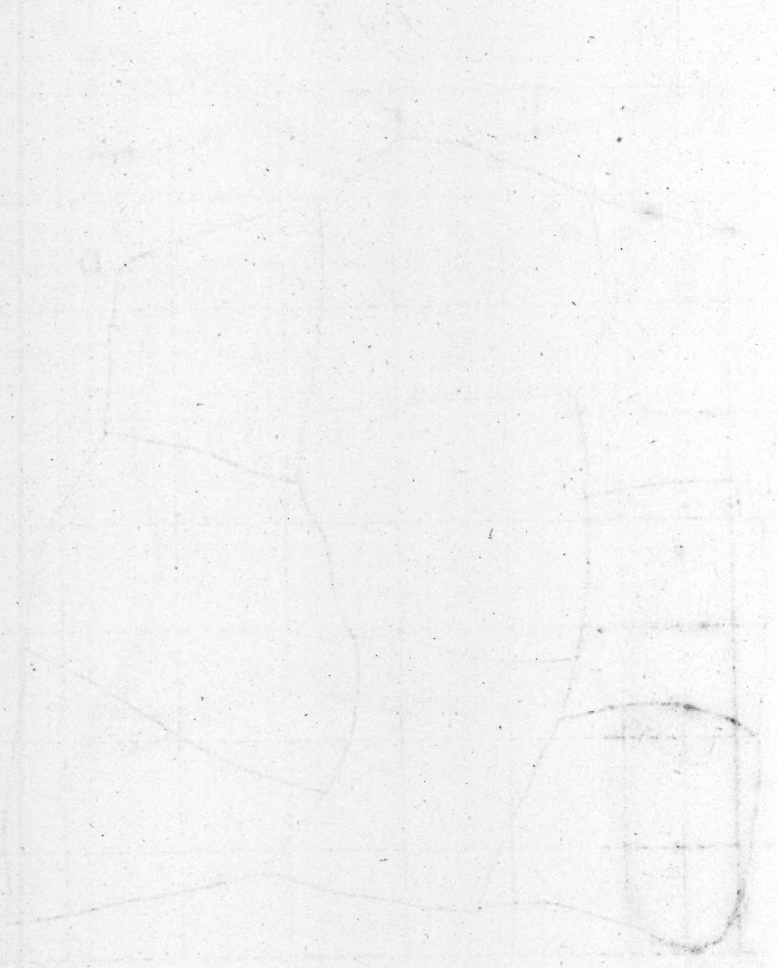


Fig 9





CHAP. VIII.

DIVISION OF LAND.

LAND, when it becomes the property of contending parties, co-heirs, joint-purchaſers, or co-partners, &c. is occaſionally divided into ſuch ſhares or parts as the co-parties are entitled thereto; and this cannot poſſibly be done or effected without having recourſe to the aſſiſtance of a ſurveyor, or ſome perſon equally qualified to perform the ſame.

When any land is to be divided, meaſure the ſame by the directions before given, before you divide it, except it is to be divided into two equal parts; and, in ſuch caſe, it may be performed with leſs trouble: then proceed by the rule of Fellowſhip. But, before you begin, you muſt be informed, by the parties concerned, where their reſpective ſhares ſhould nearly be, namely, whether in the eaſtern, weſtern, or ſouthern ſides of the land, &c. and if water be ſcarce therein, it would be proper ſo to divide, that each part may have communication with that neceſſary element; otherwiſe the parties concerned and obſtructed therefrom will certainly find themſelves aggrieved thereat, ſo as not to acquieſce in, or conform to, the diviſion.

EXAMPLE I.

It is required to divide 566 acres of land among A, B, and C, whoſe claims upon it are reſpectively in proportion as the numbers 5, 7, and 9.

```
   566
     5
   ———  A   R   P
21)2830(134 . 3 . 1 19/21 A's ſhare
   21
   ———
    73
    63
   ———
   100          5
    84          7
   ———          9
    16         ——
     4         21 ſum
   ———
21)64(3
   63
   ———
    1
   40
   ———
21)40(1
   21
   ———
   19
```

566
7
a r p
21)3962(188.2.$26\frac{14}{21}$ B ſh.
21
186
168
182
168
14
4
21)56(2
42
14
40
21)560(26
42
140
126
14

566
9
a r p
21)5094(242.2.$11\frac{9}{21}$ C ſh.
42
89
84
54
42
12
4
21)48(2
42
6
40
21)240(11
21
30
21
9

A	R	P		
134	3	$1\frac{19}{21}$	A's	ſhare
188	2	$26\frac{14}{21}$	B's	
242	2	$11\frac{9}{21}$	C's	
566	0	00		

EXAMPLE II.

It is required to divide 780 acres among A, B, and C, whoſe eſtates are 1000, 3000, and 4000 pounds a year; the ground in their ſhares being worth 5, 8, and 10 ſhillings the acre reſpectively.

Here their claims are 1, 3, 4, and the qualities of their land are as 5, 8, 10; therefore their quantities muſt be as $\frac{1}{5}$, $\frac{3}{8}$, $\frac{2}{5}$, or, by reduction, as 8, 15, 16. Now the ſum of theſe numbers is 39; by which dividing 780 acres, the quotient is 20; which being multiplied ſeverally by three numbers 8, 15, 16, the three products are 160, 300, 320, for the ſhares of A, B, C reſpectively.

EXAMPLE III.

To cut off from a plan a given number of acres, &c. by a line drawn from any point in the ſide of it.

Let A be the given point, from which a line is to be drawn, cutting off, ſuppoſe 5 acres, 2 roods, and 14 poles. Fig. 4, plate 5.

Draw AB, cutting off the part ABC, as near as can be judged, equal to the quantity propoſed; and let the true quantity of ABC, when calculated to be only 4 acres, 3 roods, and 20 poles, which is leſs than 5 acres, 2 roods, and 14 poles, the true quantity, by 0 acres, 2 roods, and 34 poles, or 71250 ſquare links; then meaſure AB, which ſuppoſe = 1234 links, and divide 71250 by 617, the half of it, and the quotient 115 links will be the altitude of the triangle to be added, and whoſe baſe is AB. Therefore, if upon center B, with the radius 115, an arc be deſcribed, and a line be drawn parallel to AB, touching the arc, and cutting BD in D; and if AD be drawn, it will be the line cutting off the required quantity ADC.

If the firſt piece had been too much, then D muſt have been ſet below B.

In this manner the ſeveral ſhares of commons to be divided may be laid down upon the plan, transferred from thence to the ground itſelf.

EXAMPLE IV.

How to divide a field that is in the form of a triangle into two parts, in any proportion, by a line drawn from any angle thereof.

Suppoſe the field ABC contains 11 acres, and at the angle B there is a pond, and I am to divide this field between two tenants by a ditch drawn from the pond at B, and that each may have the benefit of the pond; he that has that part towards the angle A to have 4 acres, and the other to have 7 acres. See fig. 5, plate 5.

Divide the line AC at D, in ſuch proportion that AD may be four parts, and DC 7 parts; and from D draw the line BD; it ſhall repreſent the ditch, that divides the field, as required.

Or thus:

Suppoſe the length of the ditch 16 chains 17 links, or 1617 links.

```
      1617
         4
      ----
  11)6468(588
      55
      ---
       96
       88
       ---
        88
        88
        --
```

Now, ſet 5 chains 88 links from the corner of the field at A to D, and draw BD; it is the place where the ditch is to be made.

EXAMPLE V.

From an angle in a given triangle, to draw lines to the oppoſite ſide, dividing the triangle into any number of parts, which ſhall be in any aſſigned proportion to each other, ſee fig. 6, plate 5. Divide the baſe into the ſame number of parts, and in the ſame proportion, by the rule of fellowſhip. Then from the ſeveral points of diviſion draw lines to the propoſed angle, and they will divide the triangle as required; for the ſeveral points are triangles of the ſame altitude, and which therefore are as their baſes taken in the aſſigned proportion.

Let the triangle ABC, of 20 acres, be divided into five parts, which ſhall be in proportion to the numbers 1, 2, 3, 5, 9, the lines of diviſion to be drawn from A to CB, whoſe length is 1600 links, fig. 6, plate 5; here 1+2+3+5 +9=20, and 1600÷20=80, which being multiplied by each of the proportional numbers, we have 80, 160, 240, 400, and 720; therefore make ca=80, ab=160, bc=240, cd=400, and dB=720, then by drawing the lines Aa, Ab, Ac, Ad, the triangle is divided, as required.

EXAMPLE VI.

A triangle field ABC (Fig. 7, plate 5) is to be divided equally among four tenants; but in the ſide AC there is a pond at D, which every tenant is to have an equal right to; the queſtion is how to ſet out each man's ſhare? From the point D draw the line DB to the angle B, and then divide the ſide AC, of the right angle, into four equal parts (the number of tenants), in the points a, t and g, from each of which draw lines parallel to DB, till they cut the ſides AB and BC, and from theſe interſections to the point D draw the line Dd, De, and Df, then ſhall the four parts ADd, dDe, eDf, and fDc, be the parts required, yet all participating of the pond at D.

EXAMPLE VII.

Let the field in the triangular form R, S, T, fig. 8, plate 5, of 6 acres 20 poles, be divided between A, B, C and D, in proportion as 1, 3, 5 and 7, from the pond in the hedge at V, as each perſon may have the uſe of the water. Meaſure the baſe RT=1325 links; draw a line from the point V to the point S; then 1+3+5+7=16, and 1325÷16=82 links, which being multiplied by each of the proportional numbers we have 82, 248, 414, and 579; therefore make vb=82, vn=248, be=414; from theſe points draw lines parallel to VS, that is, the lines ng, bt, and ex; then by drawing the lines Vg, Vt, and Vx, the field is divided into the proportions required.

Here follows the content of each man's ſhare.

A.	R.	P.	
0	1	16	A's ſhare.
1	0	4	B's do.
1	3	27	C's do.
2	3	13	D's do.
6	0	20	Proof.

EXAMPLE. VIII.

A gentleman has in his eſtate a triangle or field A, B, C, containing 3 acres; now he would have a garden taken out of the ſaid field, to contain juſt one acre, to be divided from the field by the line DE, drawn parallel to Ac.

There being two acres to be left in the triangle DBE, and but one acre to be cut off in the trapezium DEAC. Divide the line BA in the ſame proportion; viz. in three equal parts, (the number of acres) of which ſet two points from B to g, and one from g to A; then find a mean proportional between Bg and BA; it will beline BD: draw DE parallel to AC; it is the line or hedge required.

CHAP. IX.

Of **Colours** *proper to be uſed in waſhing or ſhading Maps and plots, and how to prepare them, and lay them on.*

Before I ſpeak of the colours themſelves, it will be neceſſary to give an account of the proper liquids to mix them with, ſo as that they may be ſo tranſparent as not to obliterate or deface the lines, trees, houſes, or whatſoever is neceſſary or ornamental to the Map, and yet that they may be durable, ſo as not to fade and decay, and likewiſe ſo ſtrong as not to ſink ſo much into the paper as to deſtroy the original beauty and ſtrength thereof; and theſe waters are made as follow:

To make Allum Water.—Take a pound of allum, and beat it to powder; then put it into a gallon of water, and boil it till the allum be melted, and when cold, put it into a veſſel for uſe.

Note.—If you wet your paper with it before you lay the colours on, it will not only keep them from ſinking into it, but alſo add a luſtre and beauty to them when laid on.

To make Gum Water.—Take a quantity of the whiteſt and cleareſt gum arabic, and bruiſe it into ſmall pieces: then put them into a fine linen rag, and hang the ſame in clean water till it be diſſolved; then put your finger into the water and try its ſtiffneſs, for if it feel too glutinuos, add water; but otherwiſe, add more of the gum, at your diſcretion.

Note.—You muſt temper moſt of your colours with this water.

The names of COLOURS *proper to waſh and adorn Maps, &c.*

Greens.—Verdigriſe, ſap-green, verditure, Bice.

Yellows.—Saffron, yellow berries, maſſicot, gamboge.

Blues.—Ultramarine is the beſt blue; indigo, logwood, bice, verditure, litmoſe.

Blacks.—Lamp-black, printers' black, Indian ink, burnt ſhavings of ivory or hartſhorn, &c.

Whites.—White lead in flakes.

Browns.—Soot of wood, rinds of walnuts, Spaniſh brown and umber.

Reds.—Carmine is the beſt; Indian cakes, vermilion, red lead, roſet, turnſol, brazil, ſcarlet, flocks, lake, &c.

Now as theſe colours (according to their nature) are to be ground, waſhed, ſteeped, diſſolved, boiled, or perhaps burnt, before they are ground; here follow the various methods of ordering them.

To Grind a Colour.—Put the colour on the grinding ſtone, and break it pretty ſmall with your muller, if it be in lumps, and pour a little water at a time to it, as occaſion requires, and ſo grind it with your muller till it be very fine, and then put it into any thing, and when dry reſerve it for uſe.

Note.—The colours that want grinding, are, vermilion, lake, indigo, white lead and maſſicot.

To Waſh Colours.—Put the colour and ſome clean water into a baſon, often ſtirring it together; then let the colour ſettle, and pour the water off, and put in more clean water, doing as before; ſo repeating the method till the water you pour off has nothing of filth ſwimming at the top. Now, before you take the colour out of the baſon, daub it thin about the ſides, and as it dries ſome will drop down, though what at laſt ſticks to the ſides is the better colour;

all which things put on a ſheet of paper, the better ſtill to dry it, and it is done.

Note.—The colours to be waſhed are, red lead, bice, roſet, verditure, and Spaniſh brown.

To Steep Colours—is to diſſolve them in liquor, either hot or cold; and the colours to be diſſolved in cold liquors, are, litmoſe, ſaffron, yellow berries, ſap-green, Indian cakes, and gamboge; but the colours to be ſteeped, or boiled, are rind of walnuts, French verdigriſe, turnſol, brazil, logwood, and wood ſoot.

Note.—Colours ſteeped in hot liquors are to be kept cloſe in glaſſes.

To Burn Colours.—Put your colour and water in a crucible, and cover the crucible with clay, ſetting it in a hot place of the fire till it be red; then take it out of the fire, and the colour out of the crucible when it is cold, and it is fit to grind.

Note.—Colours requiring burning, are, lamp-black, hartſhorn, Spaniſh brown, ivory, printers' black, umber, and other groſs ones.

To Temper Colours.—Put your colours into a deep ſhell, and ſome gum water to it, which will ſoon molify it, and with your finger put the colour againſt the ſhell, till all the knots be diſſolved; then with your pencil ſtroke the colour from the ſide of the ſhell to the bottom, and it is done;

only obſerving, if it be too thick, to add more of the gum water to it.

Note.—Waſhed colours are thus to be tempered; but as to ſteeped ones, the liquor of them is only to be uſed.

The ordering each colour, without commixture, to the beſt advantage.

Reds.—Vermilion, if ground and tempered with weak gum water, gives a deep red, or ſcarlet colour.

Roſet, waſhed and tempered with gum water, is at firſt almoſt like lake, though ſubject to fading; but tempered with brazil water, it will be of a deep colour.

Carmine, tempered with gum water, not ſtiff, gives the beſt of reds.

Lake, ground or tempered with gum water, is a deep pink or bloom colour.

Red lead, waſhed, is a colour between a red and an orange.

Turnſol, put into vinegar, with ſome gum water, over a chafing diſh, and well ſqueezed in the liquor, will give a good colour for ſhadowing any yellow with.

Indian cake, thus managed, is a good tranſparent red.

Brazil, the filings or raſpings, in vinegar and ſmall beer, in an earthen veſſel, with powder of alum boiled to heighten the colour, gives a light violet colour.

Note.—After you have ſtrained it off, it is proper to add a little gum arabic to it.

Scarlet flocks, boiled gently in water about five hours, putting in a ſpoonful of ſoap lees, gives a tranſparent red or ſcarlet colour.

Greens.—Verditure, waſhed and tempered with gum water, makes no tranſparent green; but half a pound of French verdigriſe, with an ounce of argol, boiled in a quart of water, makes a good tranſparent green, inclined to a blue.

Note.—This colour requires about five hours gentle boiling, and when it is done, it muſt ſtand a conſiderable time ſettling, that you may pour the clear from it.

Bice, waſhed and tempered with gum water, makes a good green, though not tranſparent.

Sap-green, ſteeped in water with a little alum powdered, is a good green to ſhadow with.

Yellows.—Saffron, ſteeped in water at night, makes an excellent gold colour.

Yellow berries, ſteeped in allum water, is a tranſparent yellow.

Maſſicot, ground and tempered with gum water, is a good, though not tranſparent, yellow.

Gamboge, with water only, does, at laſt, make the beſt and moſt tranſparent yellow.

Blues.—Ultramarine, tempered with weak gum water, is the beſt blue.

Indigo, tempered and with gum water, is a deep blue, and fit to ſhadow blues with.

Logwood, managed as bazil (which ſee among the reds), is a very good purple.

Bice, waſhed and tempered with gum water, is a good blue, though not tranſparent, of which there are ſeveral ſorts, lighter or darker.

Verditure, ſo managed, is a good blue, but not tranſparent.

Litmoſe, cut into ſmall ſlices, and ſteeped in weak water (made of gum black) a day or more, is a tranſparent blue.

Blacks.—Lamp black, printers' black, ivory and hartſhorn ſhavings, but ground and tempered with gum water, are all good blacks.

Indian ink, ground and tempered with weak gum water, is the beſt black to ſhade deeper black with.

Whites.—White lead, ground and tempered with gum water, is the beſt white.

Wood ſoot, or rinds of walnuts, boiled in water, and ſtrained with ſome gum water to it, either of them is a good colour to diſtinguiſh roads, &c. by.

Umber, burnt, ground, and tempered with gum water, is a good ſtraw colour, and looks well on gold.

Spaniſh brown, as ordered, makes a good liver colour.

Now, as theſe colours are in all reſpects ſufficient in themſelves to beautify any draught, I ſhall only ſhew how they may be made darker or lighter; by mixing thoſe of different kinds together, as greens with yellows, &c.: for though the colours mentioned be ſufficient, yet it may be requiſite it ſhould be paler or darker; therefore, as to a green, verdigriſe water, and yellow-berry water, according as they are mixed, make a lighter or darker green, and, as being tranſparent, is a colour better for this uſe.

And you may obſerve alſo, that a different colour may be produced by mixing different colours together; as a deep green may be made of litmoſe and yellow-berry water mixed together, viz. a blue and a yellow, &c.

Knowing how to make a colour lighter or darker, you are able to make colours proper to ſhadow with, as light colours are always ſhadowed with darker of the ſame nature, viz. lighter green with deeper, &c. as for inſtance, obſcure.

Verdigriſe, may be ſhadowed with indigo and yellow-berry water mixed together.

Gamboge and yellow-berries may be ſhadowed with umber mixed with red lead or vermilion.

Verditure and bice with indigo.

Spaniſh brown may be ſhadowed with umber and brazil water mixed together.

Wood ſoot and walnuts with burnt umber, &c.

Which is obvious to any one that can rightly diſtinguiſh colours ſingly of themſelves, and have a notion of producing others by co-mixing thoſe of different kinds, &c. as I have already mentioned. Having your colours ready for ſhadowing, and all in order to lay them on your draught, it is preſuppoſed you are ſtocked with pencils, ſo as to have pencils of different ſizes for each colour, to prevent the trouble of frequently cleanſing them (in water with a linnen rag), as you ſee occaſion to uſe different colours for one uſe or other

Chuſe pencils by their fulneſs of hair next the quill, which ought gradually to leſſen to the end in a point, as you may try by drawing it through your lips.

Now, as to the actual laying on the colour: ſuppoſe you had the plan of a ſurvey only in its lines, and would lay the colour about a field in it: dip your pencil into the colour, and draw it along, of an equal breadth, about the field, in the inſide thereof, broader or narrower, as the field is more or leſs in quantity; then juſt wet your pencil in water, and pencil off by degrees what you before begun, towards the middle of the field: only note, your are to pencil off only from the inſide of the coloured breadth; for by this means the colour from the outſide of the field will ſeem by degrees to vaniſh, and to look the more beautiful to the eye. And when landſcapes are divided into ſeveral tenures, or great eſtates ſo divided, it is proper, in one entire colour, to ſtrike out each parcel, and a different colour to each parcel is needful: and it is adviſable that every adjacent field ſhould be bounded with a colour ſomewhat different, which muſt be referred to the judgment of the artiſt, as the colouring of Maps is not always for ornament only.

PART III.

Teacheth the method of levelling or conveying of water from one place to another: likewiſe the method of meaſuring hay ricks, marl pits, and timber; alſo, all kinds of artificer's work, the manner of taking dimenſions with the cuſtomary additions and deductions.

CHAP. I.

OF LEVELLING.

TO know whether water may be made to run from a ſpring head to any place appointed, though at a conſiderable diſtance, either in pipes or canals.

Levelling is the finding a line parallel to the horizon, at one or more ſtations, and ſo to determine the height of one place with regard to another.

A truly level ſurface is a ſegment of any ſpherical ſurface which is concentric to the globe of the earth, and of ſo much is the ſea. A true line of level is an arch of a great circle which is imagined to be deſcribed upon a truly level ſurface.

The apparent level is a ſtraight line drawn tangent to an arch or line of true level. Thus let GCE (fig 1, plate 6,) be the arch of a great circle of the earth F, as center GE, the rational horizon to a perſon at C; then BCD is the line of apparent level, being a tangent to the arch LCK of true level; and alſo parallel to the rational horizon GE, every point of the apparent level, except the point of contract is higher than the true level; for B is farther from F than C is, and A is farther than B, &c.; therefore the greater the diſtance from C, the more the apparent level differs from the true; if two points, L and K, be equally diſtant, from C, then will the difference of the true and apparent level be equal at each place, that is, BK = to DL, but if the two points be at unequal diſtances from C, as A and L, then will the difference of true and apparent level be different; from AI is greater than DL, and therefore in all ſuch caſes it is neceſſary to know what the difference between the true and apparent level is for any diſtance from C, and may be found thus:

Suppoſe the diſtance CB be one mile, then is the right angled triangle BCF, given BC = to one mile, and CF = 4000 miles, = the earth's ſemidiameter to find BF. Now (per. 47, Euclid 1.) the ſquare of CE + ſquare CB = ſquare BF = 16000001, whoſe ſquare root is 4000.000125 = BF, and CF or KF taken from BF leaves BK, the difference of level at B equal 0.000125 parts of a mile, = 7.92 inches, or 8 inches nearly; therefore the apparent level exceeds, or is higher than the true level by 8 inches = equal BK, at the diſtance of one mile from C; and as CF is conſtant, it will be as the ſquare of BC is to BK, ſo is the ſquare of AC to AI, &c. and by taking BC = 80 chains. The following table was calculated, ſhewing the difference of true and apparent level, from 5 to 100 chains diſtance:

Diſt. in chains.	Diff. lev. ſub. in.	Diſt. in chains.	Diff. lev. ſub. in.
5	0.03	55	3.78
10	0.12	60	4.5
15	0.28	65	5.31
20	0.5	70	6.12
25	0.78	75	7.03
30	1.12	80	8.
35	1.53	85	9.03
40	2.	90	10.12
45	2.53	95	11.28
50	3.12	100	12.5

Being provided with a ſpirit, or water level, which may be had at moſt mathematical inſtrument makers, and alſo two poles, about 8 or 10 feet long, divided into feet, inches, and parts, having a ſmall circular board, &c. (about 4 inches diameter) ſo fixt on each pole or ſtaff, that it may be ſhifted down or up at pleaſure; then by the help of two aſſiſtants, viz. one for each ſtaff, after having faſtened ſome white paper on the abovementioned ſmall boards, with a black line drawn acroſs the middle thereof, to which your obſervation hath reſpect: then make for the ſpring head, and there cauſe your firſt aſſiſtant to fix his ſtaff perpendicular; direct the other to go about 100 or 200 yards (as you ſhall find moſt convenient) towards the place deſigned for bringing the water to; there let him ſtand and hold his ſtaff perpendicular alſo; then ſet your inſtrument about midway between them, making it ſtand level, that is horizontal; look through the ſights thereof to your firſt aſſiſtant's ſtaff, moving the abovementioned white paper up and down the ſtaff, according to the ſigns you make to him, till through the ſights you eſpy the black line on the paper; then by a ſign make him to underſtand that you have done with him; and let him write down howmany feet, inches, and parts, the paper reſted upon; alſo, going to the other end of your level, do the ſame by the ſecond aſſiſtant, and let him write down alſo what number of feet, &c. the paper was from the ground. This done, let your firſt aſſiſtant come to the ſecond aſſiſtant's place, and there let him again ſtand with the ſtaff; and let the ſecond aſſiſtant go forward 100 or 200 yards as before, and placing yourſelf and inſtrument in a line between them, take your obſervations as before, and let them put them down in like manner; and ſo you muſt do till you come to the place where the water is to be conveyed. Then examine the notes of both your aſſiſtants; and if the notes of the ſecond aſſiſtant exceed that of the firſt, you may be ſure the place is lower than the ſpring head, and that therefore water may be well conveyed; but if the firſt's notes exceed the ſecond's, you may conclude it impoſſible, without engines or the like.

EXAMPLE I.

It is required to find if water can be brought from a ſpring on the ſide of a hill at R, to the houſe at S, in pipes. (See fig. 2, plate 6.)

Firſt. Fix your inſtrument at any convenient diſtance from the ſpring, ſuppoſe 5 chains; next enter the difference between the true and apparent level, 0.03 inches, taken from the foregoing table; let your firſt aſſiſtant place one ſtation ſtaff at a, the ſpring, and the other toward S at b; direct your teleſcope to the ſtaff at a, and inſtruct your aſſiſtant to place the vane, ſo as when the ſtaff is held perpendicular, the hair in the teleſcope may cut the middle of the vane, viz. 6.5 inches, which enter in the field book under back ſights; next, take the foreſight to the ſtaff b, viz. 3 feet 6.4 inches, which enter under foreſights; then meaſure from the inſtrument to the ſtaff at b, viz. 16, which enter in the column diſt. and in the next column againſt it, is the difference between the true, and apparent level, 0.28 inches; then meaſure to ſtation 2=12 chains, which enter, and againſt it the difference between the true and apparent level 0.12 inches; take the back ſight to the ſtaff b, viz. 1 foot 2.7 inches, which enter: next take the foreſight to the ſtaff at c=2 feet 6.9 inches, which enter; next meaſure from the inſtrument to the ſtaff at c, viz. 10 chains, which enter in the field book, and againſt it the difference between the true and apparent level

0.12 inches; then meaſure on to the third ſtandtion, viz. 15 chains, which enter under diſt. and againſt it, 0.28 inches, the difference between the true and apparent level; next turn the teleſcope towards the ſtaff remaining at c, and take the backſight, viz. 2 feet 08 inches, which enter in the field book; then take your foreſight to the ſtaff d, viz. 4 feet 6.5 inches, which enter; next meaſure from the inſtrument to the ſtaff at d = 13 chains, which enter, and againſt it the difference between the true and apparent level. Now having arrived at S, and finiſhed your level, add up all the columns; then from the ſum of the height, under book ſights, take the ſum of the difference of the level under the ſame, the remainder will be the correct ſum of the heights of the vane; do the ſame under the foreſights, and the difference of theſe corrected heights gives the difference of true level; and the ſum of the diſtance under both diſtances will be the whole diſtance from R to S.

FIELD BOOK.

The firſt aſſiſtant's notes, or back ſights.				The ſecond aſſiſtant's notes, or fore ſights.			
St.	Ht. V. Ft. In.	Diſt. Ch.	Diff. Lev. Inches.	St.	Ht. V. Ft. In.	Diſt. Ch.	Diff. Lev. Inches.
1	0.6.5	5	0.03	1	3.6.4	16	0.28
2	1.2.7	12	0.12	2	2 6.9	10	0.12
3	2.0.8	15	0.28	3	4.6.5	13	0.12
	3.8.20	32	0.43		10.6.18	39	0.62
	0.0.43				0.0.62	32	
	3.7.77				10.5.56	71	
					3.7.77		
					6.7.79		

Here the ſum of the heights of the vane in the fore ſights exceeds thoſe of the back ſights 6 feet 7¾ inches; and ſo much is S below the true level of R, and the whole diſtance being 71 chains.

EXAMLE II.

It is required to find if water can be brought from a ſpring, on the ſide of a hill at M, to a reſervoir at N. See fig. 3, plate 6.

Begin at the ſpring M, and meaſure towards N, till you come to the brow of the hill at ſta tion 1; ſuppoſe 10 chains, which enter in the column of diſtances under back ſights; in the next column enter the height of the vane, viz. 0.4.2 inches; and then the difference of the true and apparent level, viz. 0.12 inches; then take the fore ſight to the ſtaff at b, viz. 2 feet; next meaſure the diſtance from the inſtrument to the ſtaff at b=12 chains, which enter, and againſt it the difference between the true and apparent level 0.12 inches; then meaſure from the ſtaff at b, to the ſecond ſtation=15 chains, which enter; and againſt that, the difference between the true and apparent level, viz. 0 28 inches; next take the back ſight=1 foot, which enter alſo; then take the fore ſight, viz. 0.7.5 inches, and meaſure the diſtance from the inſtrument to the ſtaff at c=20 chains, which enter; and in the next column againſt it the difference between the true and apparent level, =0.5 inches; do the like when the inſtrument is at ſtations 3, 4, 5 and 6, always taking care to keep the ſtaff in the ſame place when you looked at it for a foreſight, till you have alſo taken it at a back ſight; being arrived at N, add up all the columns, except the ſtations; then from the ſum of the heights, under back ſights, take the ſum of the difference of the true and apparent level under the ſame, the remainder will be the correct ſum of the heights of the vane; do the ſame under the fore ſight, and the difference of theſe corrected heights gives the difference of the true level, and ſum of the diſtances under both ſights will be the diſtance.

The firſt aſſiſtant's notes, or back ſights.				The ſecond aſſiſtant's notes, or fore ſights.			
St.	Ht. V. Ft. In.	Diſt. Ch.	Diff Lev. Inches.	St.	Ht. V. Ft. In.	Diſt. Ch.	Diff. Lev. Inches.
1	0.4.2	10	0.12	1	2.0	12	0.12
2	1.0	15	0.28	2	0.7.5	20	0.5
3	1.0.2	12	0.12	3	0.9.2	10	0.12
4	0.5.3	9	0.10	4	0.3.16	12	0.12
5	0.6.0	10	0.12	5	1.6.5	5	0.03
6	1.2.5	10	0.12	6	1.9.2	20	0.5
	4.5.12	66	0.88		6.10.30	79	1.39
	0.0.88				1.39	66	
	4.4.24				6.8.91	145	
					4.4.24		
					2.4.67		

Here you ſee the ſum of the heights of the vane in the fore ſights exceeds that of the back ſights, by two feet 4½ inches; and ſo much is N below the true level of M, and the whole diſtance being 145 chains, which, being divided by 80, gives 1 mile 3 quarters, and ½ a furlong; therefore the fall is about 1 foot 4 inches in a mile. When water is to be brought in pipes; they may be laid near the ſurface of the earth, down through vallies, and over the riſings, provided they be not above the level of the ſurface of the ſpring: for ſhould the fall be very great from M to N, yet if there be a riſing in the way between them, higher than the ſurface of the ſpring or well, the pipes muſt be laid ſo much deeper, ſo as to keep them below the level of the ſpring; but if the water is to be brought in an open canal, the bottom thereof muſt be carried on nearly level, only allowing for the fall; and if the ground be up hill and down, it muſt be ſunk or raiſed accordingly, unleſs you can carry on the level by going round about.

CHAP. II.

To meaſure marl pits.

MARL is an excellent manure for land, and is much uſed in Cheſhire, Lancaſhire, and the adjacent counties, whereof the inhabitants (who are more immediately concerned in agriculture) annually enjoy the emoluments ariſing therefrom: however, it is not my deſign, in this place, to expatiate on the properties or qualities of marl, but to direct and ſhew how to meaſure a caſt or fallen pit; but before this can be effectually performed, let us conſider the nature of this irregular vacuity.

A marl pit may be ſuppoſed to repreſent an irregular ſolid, or rather an irregular vacancy, in the earth, made by poor labourers, who commonly lay out the pit at firſt, in imitation of a ſquare or rectangle; but the conſequence of working ſuch ſo true and upright is exceeding dangerous, and too often attended with broken bones and loſs of lives, as workmen are generally paid for marl pits by the rood. I ſhall, in the next place, explain what a rood is, and then teach how to find how many roods there are contained in the moſt irregular marl pits. Then, 8 yards long, 8 broad, and 1 deep, = 64 cubical yards, were formerly accounted a rood of marl; but cuſtom hath eſtabliſhed, in ſome counties, 9 yards long, 8 yards broad, and 1 deep, equal to 72 cubical yards to the rood; now, as ſuch pits are allowed to repreſent irregular bodies, conſequently, whoever would attempt to meaſure or find the true content thereof, ſhould not be a ſtranger to, or unacquainted with, the menſuration of regular ſolids; yet, notwithſtanding, how oft do we ſee numbers, in this country, who can ſcarcely define a line, or conſtruct a ſquare, much leſs meaſure a curved ſpace, or an irregular ſolid; who will, nevertheleſs, arrogantly aſſume ſuch boaſting pretenſions to this art, as if they were perfectly acquainted with geometry, by which means they too often intrude upon the credulity of their well-meaning neighbours. And, therefore, for want of ſuch neceſſary qualifications, how frequently do we ſee the induſtrious farmer, or perhaps the poor laborious workman, impoſed upon, by employing ſome bungler or other to meaſure their work, whoſe incapacity muſt render them obnoxious to every individual who hath any knowledge of ſuperficies and ſolids. The conſequence of employing an unqualified perſon upon the occaſion, cannot fail of proving injurious to one or the other concerned therein.

To meaſure a rectangle pit, the angles whereof are right ones, or nearly ſo, and the ſides and backs are nearly ſtraight.

RULE.

Multiply the main length of the pit's body by the main breadth, and that product by the main depths: this laſt product will be the content in cubical yards.

Secondly. Multiply the main length, main breadth, and main depth of the pace (or ſpace, as it is commonly called) together, and the product will be the content thereof in cubical or ſolid yards; which add to the content of the body of the pit, and divide the ſum by 64 or 72 (according to the cuſtom of the country), and the quotient will be the number of roods of marl the pit did contain.

The main length of a pit may be found thus: Take the length of one ſide, about the middle depth, with a ſtring, in which place ſtick or faſten a pin, and then, with a decimal yard, meaſure it, and enter the ſame; do ſo at every three yards acroſs the pit; but, obſerve, you need only meaſure to or from the pin you firſt faſtened in the ſtring; then add or ſubtract the difference to or from the firſt length entered; which done, divide the ſum of the lengths by the number thereof, and the quotient will be a main length. In like manner find the main breadth: the main depth, according to the practical cuſtom, is thus obtained; being provided with a pole about 5 yards long, divided into yards and decimal parts: alſo take the depth therewith perpendicular to the floor of the pit, on each ſide thereof, about 3 yards aſunder; but ſee you do not meddle with the back part, unleſs you take the depth of the front alſo, which may be performed by holding the ſtring or line, at full ſtretch, level with the graſs or ſurface, &c. on each ſide of the pit, exactly over the place where the ſpace and body of the pit divides; then, with the pole and decimal yard, take as many depths as you did at the oppoſite ſide or back part: add all theſe depths together, and divide the ſum by the number thereof; the quotient will be a main depth: proceed in like manner to find the length, breadth, and depth of the ſpace, then will your dimenſions of the pit be completed.

EXAMPLE I.

Let fig. 4, plate 6, repreſent a marl pit, the ſides whereof are nearly perpendicular, and the angles nearly right, i. e. neither much obtuſe, nor acute; the content thereof is required.

The lines d d are the different lengths taken, by a pack-thread ſtring, in the pit above the middle of the depth; and the lines c c are the different breadths taken in like manner; the depths were taken at every two yards from each ſide of the pit.

Lengths in yards	Breadths in yards	Depths in yards
12.20	9.52	5.20
12.28	9.40	5.30
12.70	9.20	4.90
12.60	9.30	4.84
12.40	9.28	4.60
12.19	9.48	4.70
12.24	9.60	5.00
12.30	9.70	4.80
12.42	9.42	4.50
		4.40
9)111.33	9)84.90	
		10)48.24
12.37	9.43	
		4.82

```
 Main length   12.37
Main breadth    9.43
               -----
                3711
               4948
             11133
             -------
            116.6491
Main depth      4.82
            --------
             2332982
            9331928
           4665964
           ----------
           562.248662
           ----------
```

Anſwer 562.248 cubical yards in the body of the pit.

SPACE.

Lengths	Breadth	Depth
4.20	5.52	2.42
3.98		
2)8.18		
4.09		

Main length 4.09
Main breadth 5.52
8.18
2045
2045
22.5768
2.42
451536
903072
451536
Solid yards in the ſpace 54.635856
In the body 562.248662
The pit contains cubical 616.884518 yards

Divide 616 yards by $\left\{\begin{matrix}64\\ \text{or}\\ 72\end{matrix}\right\} = \left\{\begin{matrix}\text{11 roods 12 yards}\\ \text{8 roods 40 yards}\end{matrix}\right.$

The content required.

EXAMPLE II.

Let fig. 5, plate 6, repreſent a marl pit, the ſides of which are ſtraight; I demand how many roods are contained therein.

yards

$$\text{Perpendiculars}\begin{cases}CD = 9.52\\ EF = 8.60\end{cases}$$

2)18.12

9.06

yards

The diagonal AB = 16.90

Depths
yards
6.04
5.70
5.90
5.40
5.80
5.60
6.00

7)40.44

5.77

yards
Length 16.90
Breadth 9.06

10140
170100

1711140
depth 5.77

11977980
11977980
8555700

Cubical yards 987.327780

Main length 2.80
Main breadth 5.20

5600
14000

14.5600
Depth 2.40

5824000
2912000

Cubical yards 34.944000
Body 987.327780

1022.271780

Divide 1022 yards by $\left\{\begin{matrix}72\\ \text{or}\\ 64\end{matrix}\right\}=\left\{\begin{matrix}\text{14 roods 12 yards}\\ \text{15 roods 62 yards}\end{matrix}\right.$

The content required.

EXAMPLE III.

Let fig. 6, plate 6, repreſent an irregular marl pit, and it is required to know how many roods of marl were contained therein.

To meaſure any marl pit that ſlips occur therein, ſtretch a line along that ſide of the pit, and, with your decimal yard, take as many breadths from the ſtring (at full ſtretch) to the back of the ſlip as you ſee neceſſary; add theſe breadths together, and divide the ſame by the number thereof, and the quotient will be the main breadth of the ſlip; then take the length and height thereof, and proceed as before.

THE BODY

The diagonal AB = 20.46 yards.

The perpendiculars $\left\{\begin{array}{l}EF = 13.70\\ CD = 11.34\end{array}\right.$

2)25.04

12.52

Depths
yards
7.49
8.11
7.90
7.80
8.00
7.24
7.50
7.60
7.70
9)69.34
7.70 main depth

yards
Diagonal 20.46
perpendicular 12.52
4092
10230
4092
2046
256.1592
Depths 7.70
179311440
179311440
Cubical yards 1972.425840

The ſpace.

yards
Main breadth 5.42
Main length 7.50

27100
37940

40.6500
depth 2.25

2032500
813000
813000

91.462500 cubical yards

The ſlip T.

yards
Main length 6.25

Heights
yards
5.90
5.60
6.00

3)17.50

5.83

breadths
3.50
3.90
3.40

3)10.80

main 3.60
yards
6.25
3.60

37500
18750

22.5000
5.83

675000
1800000
1125000

Cubical yards 131.175000

The ſlip V.

Length yards	Breadth yards	Heights yards
4.70	3.70	6.20
	4.40	6.40
	3.90	6.15
	3)12.0	3)18.75
	Main breadth 4.0	Main hei. 6.25

Main length 4.70
Main breadth 4.00

18.8000
Main height 6.25

940000
376000
1128000

Cubical yards 116.500000

The ſlip X.

Length yards	Breadths yards	Heights yards
7.20	2.20	6.70
	2.40	6.20
	2.50	6.50
	2.20	6.40
		6.20
	4)9.30	5)32.00
	2.32	6.40

Main length 7.20
Main breadth 2.32

1440
2160
1440

16.6040
Main height 6.40

6641600
9962400

Cubical yards 105.265600

The ſeveral parts collected.

The body of the pit	1972.42
The ſpace - - -	92.46
The ſlip T - - -	131.17
The ſlip V - - -	116.50
The ſlip X - - -	105.26
	2417.81

$$\text{Divide } 2417\tfrac{3}{4} \text{ yards by} \left.\begin{array}{l} 72 \\ \text{or} \\ 64 \end{array}\right\} = \left\{\begin{array}{l} 33 \text{ roods } 41\tfrac{0}{4} \text{ yards} \\ 37 \text{ roods } 49\tfrac{3}{4} \text{ yards} \end{array}\right.$$

The content required.

CHAP. III.

To meaſure hay.

Hay is an irregular ſolid, and is meaſured and returned in cubical yards; but the weight of the yard ſolid differs according to the plan and quality of the hay, to wit: a cubical yard or ſquare yard, as it is commonly called, in the bottom of ſome hayricks of one, two, or three years ſtanding, will weigh near two hundred weight; and another of the ſame ſize, and ſtanding a year, perhaps will not weigh one hundred weight; however, the meaſurer hath nothing more to do, than to find the number of cubical yards in the hayrick; and let the buyer and ſeller order about the weight thereof.

To meaſure a hayrick when both the ends are equal.

RULE.

Multiply the ſuperficial area of the end in ſquare yards by the length, and the product will be the cubical yards therein.

EXAMPLE I.

Let fig. 7, plate 6, repreſent a hayrick, the ends being equal, and the dimenſions as follow; how many ſolid yards is contained therein.

The bottom part.

Brea. at bot.	AC=3.50	Height	BG=2.90
Do. at bulge	FD=5.20	Main breadth	=4.35
	2)8.70		1450
			870
Main breadth	4.35		1160
			12.6150

The top part.

Bread. at bulge	FD=5.20	Main bread.	=3.14
Do. at the top	E=1.09	Height	GE=6.50
	2)6.29		15700
			18840
Main breadth	3.14		
		Area of the top end	20.4100
		Area of the bottom end	12.6150
			33.0250
		The length of the rick AH.	10
		Cubical yards	330.2500
		The content required	

How to meaſure a rick, the ends being unequal.

RULE.

Having found the area of each end, multiply the main area (between the two ends) by the length of the rick, and the product will be the ſolid content.

The area of each end may be thus found; mark out the ends of the rick in two parts, viz. top and bottom; then at every yard in heighth of the upper part of each end, take a breadth (but as for the bottom part, two or three breadths will do; one at the bottom, one between the bottom and bulge, and one at the bulge); divide the ſum of the breadths pertaining to each part and end by the number taken therein, the quotient will be a main breadth, near enough, which multiply by the heighth of the part and end you are meaſuring, and the product will be the true area ſought: then to find the main area of the two ends, proceed thus; to the ſquare root of the rectangle of the area of the two ends, (found as above) add thoſe two areas together, and one third part of the ſum will be the main area, which is to be multiplied by the length, as above directed.

It often happens that a rick is longer on one ſide, or in one place, than another; in that caſe, take the length as often as you ſhall think proper, or ſee needful; add them together, and divide the ſum by the number taken, the quotient will be the main length by which you are to multiply the main area to find the ſolidity.

EXAMPLE II.

Admit fig. 8, plate 6, to repreſent a large hayrick, the length being 15.54 yards, and the other dimenſions as underneath; howmany ſolid yards are contained therein?

The bottom part of the eaſt end.

Breadth at bot. AC = 5.50	The main brea. = 6.54
Do. at bulge TG = 6.89	Heighth BE = 7.20
Do. F.D = 7.24	——
——	13080
3)19.63	45780
——	——
Main breadth 6.54	Area of the bottom end 47.0880

The top part of eaſt end.

Breadth at bulge FD	=7.24	Main breadth	=4.63
Ditto at HI	=6.25	Heighth EP	=8.90
Ditto, at ML	=4.10		
Dittto, at top NO	=0.95		41670
			37040
	4)18.54		
		Area of top pt.	41.2070
Main breadth	4.63	Area of bot. pt.	47.0880
		The area of the eaſt end	88.2950

The bottom part of the weſt end.

Breadth at the bot.	=4.80	Main breadth	=5.76
Ditto, middle	6.10	Heighth	6.40
Ditto, at bulge	6.40		
			23040
	3)17.30		34560
Main breadth	5.76	Area of bot.	36.8640

The top part of weſt end.

Brea. at bulge	=6.40	Main breadth	4.08
Ditto - - -	5.65	Heighth - -	7.95
Ditto - - -	3.70		
Ditto, at top -	0.60		4040
			672
	4)16.35		2856
Main breadth	4.08	Area of top	32.6360
		Area of bottom	36.8640
			69.5000

Area of the eaſt end 88.295
Area of the weſt end 69.500

44147500
79465500
3295000

1168.302500(34.18
9 88.29
69.50
64)268
256 3)191.97
681)1230 69.99 main area
681
6828)54925
54624
301

The main area=63.99
The length AS=15.54

25596
31995
31995
6399

Cubical yards 994.4046
The content required.

How to meaſure a haycock or ſtack; the top and bottom part do repreſent the fruſtum of a cone.

RULE.

Multiply the ſquare of the circumference of the bottom, bulge, and top, ſeverally, by 079.58 (the area of a circle whoſe circumference is 1,) or by .08, which in theſe caſes will anſwer near enough, and the products will be the areas at thoſe places; then find a main area between the area at the bottom and the bulge, thus: to the ſquare root of the rectangles of the two areas, add the two areas, and one third part of the ſum will be the main area ſought, which multiply by the perpendicular height of the bottom part, and the product will be the ſolidity thereof; then to find the ſolidity of the upper part, proceed in the ſame manner, namely: find a main area between the areas at the bulge and top; by adding theſe two areas (found as above mentioned) to the ſquare root of their rectangles, and taking one third part of their ſum, the quotient will be the main area between the bulge and top areas, which multiply by the perpendicular (and not the ſlant height) of this part, and the product will be the ſolidity thereof, which add to the ſolidity of the other, viz. the bottom part, and the ſum will be the ſolidity of the whole ſtack.

EXAMPLE III.

Let fig. 9, plate 6, repreſent a hay ſtack; the dimenſions are as follow: howmany ſolid yards are contained therein?

Girt at the bottom AB=31.50×31.50=992.38 ×.08=79.38

Girt at the bul. CD=36. ×36=1296×.08=103.68

The bottom area 103.68
Area at the bulge 79.38

82944
31104
93312
72576

8230.1184(90.72 103.68
81 79.38

1807) 13011
12649 3)273.78

18142) 36284 91.26 main area
36284 5.80 height GF

730080
456300

Solid yards the bottom 529.3080

Top part.

Girt at bulge CD=36×36=1296×.08=103.68

Girt at top E=325×3.25=10.57×08 = 084

103.68
.84

41472
82944

87.0912(9.33
81 103.68
.84
183)609
549 3)113.85

1863)6012 37.95 Main area
5589 10 Height FE

423 379.50 Solid yd. in top pt.

Solidity of the bot. part 529.30
Solidity of the top part 379.50

Solid yards the content required 908.80

EXAMPLE IV.

Let fig. 10, plate 6, repreſent a large hayſtack; the dimenſions are as follow: howmany ſolid yards are contained therein?

Bottom part.

Girt at bottom CC=42.50×42.50=1806.25 ×.08=128.50

Girt at DD=54.75×54.75=2997.56×.08=239.80

```
Area at bottom CC   128.50
Area at DD    -    =239.80
                   -------
                   1028000
                  1156500
                  385500
                 257000
                 -----------
                 30814.3000(175.53
                 1             128.50
                 ---           239.80
              27)208           ------
                 189        3)543.83
                 ---           ------
             345)1914          181.27 Main area
                 1725               3 Height RL.
                 ----          ------
            3505)18900         543.71 Solid yards
                 17525
                 -----
           35104)140500
                 140416
                 ------
                     84
```

Girt at DD=54.75×54.75=2997.56 × 08= 239.80

Girt at the bulge EE=57.50×57.50=3306.25 ×08=264.50

Area at DD=239.80		
Ditto, at EE=264.50		
199000		
959200		
1438800		
479600		
63427.1000(251.84		
4	239.80	
—	264.50	
45)234		
225	3)756.14	
501)927	252.07	Main area
501	3	Height LM.
5028)42610	756.21	Solid yards
40224		
50364)238600		
201456		
37144		

Top part.

Girt at EE = 57.50 × 57.50 = 3306.26. × 08 = 264.50

Girt at FF = 44.40 × 44.40 = 1971.36×08 = 157.70

Area at EE = 264.50
Area at FF = 157.70

1851500
1851500
1322500
464500

617116500(248.41
4 264.50
— 157.70
44)217
176 3)670.61
488)4111 223.60 Main area
3904 3. Height MN.
4964)20765 660.80 Solid yards
19856
49681)90900
49681
41219

Girt at FF = 44.×4044.40 = 1971.36×.08 = 157.70

Girt at GG = 36.25×3625 = 1314.06×.08 = 105.25

Area at FF 157.70

Area at GG 105.25

78850

31540

78850

157700

16597.9250(128.88

1 157.70

105.25

22)65

44 3)391.78

248)2197 130.59 Main area

1984 3 Height NO

2568)21392 391.77 Solid yards

20544

25763)84800

76289

8511

Girt at GG = 36.25×36.25 = 1314.09×.08 =
105.25

Girt at HH = 19.20×19.20 = 368.64×08 =
29.49

```
           105.25
            29.49
           ------
            94725
           42100
          94725
         21050
         ---------
         3103.8225( 55.71
         25            105.25
         ---            29.49
      105)603          -----
          525        3)190.45
          ---          ------
     1107)7882          63.48  Main area
          7749           2.50  Height OP
          ----         ------
   11141)13325         317400
         11141        126960
         -----        --------
          2184        158.7000  Solid yards
```

Girt at HH = 19.20 × 19.20 = 368.64 × .08 = 29.49

Girt at II top = 4.50 × 4.50 = 20.25. × 08 = 1.62

29.49
1.62
5898
17694
2949
47.7738(76.91
36
129)1177
1161
1381)1638
1381
257

29.49
1.62
3)38.02
12.67
1.20 Height Pq.
25340
12670
15.0040 Solid yards

The ſolid content of the bottom part	1	543.71
	2	756.21
Ditto of the top part	1	660.80
	2	391.77
	3	158.70
	4	15.00
The content required in ſolid yards		2526.19

Plate 6.

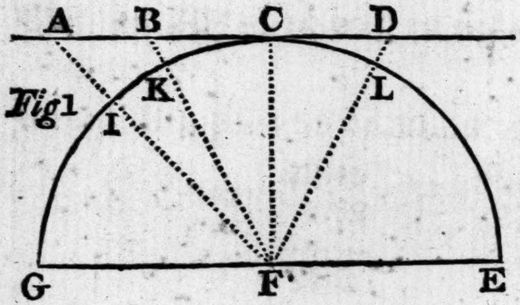
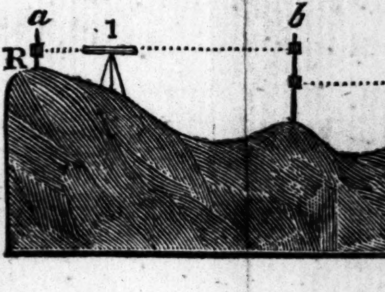
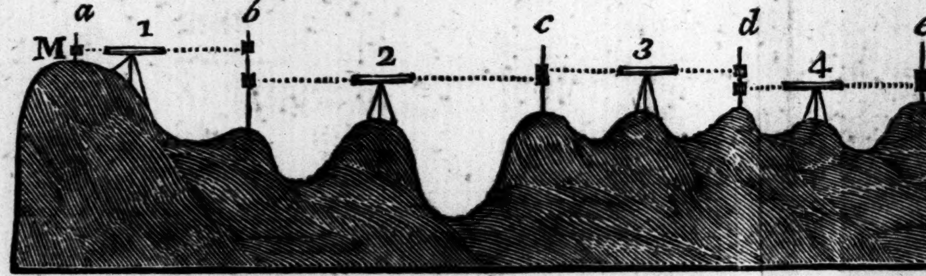


Fig 1





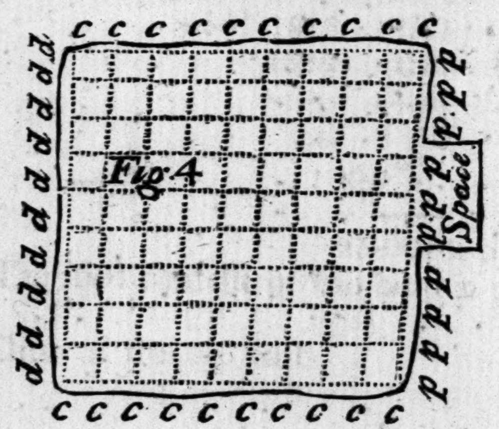


Fig 4

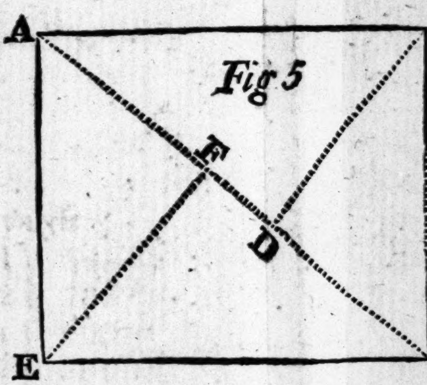


Fig 5

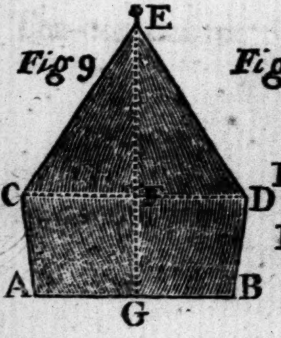


Fig 9

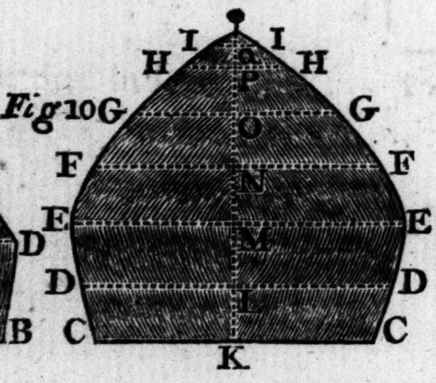


Fig 10

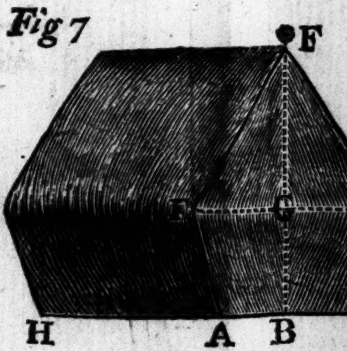


Fig 7

Plate 6.

Fig 2

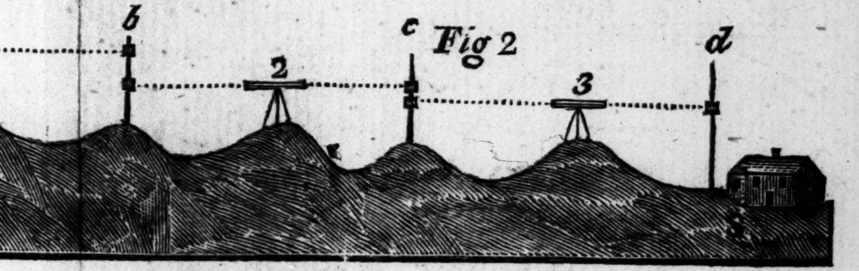


Fig 3

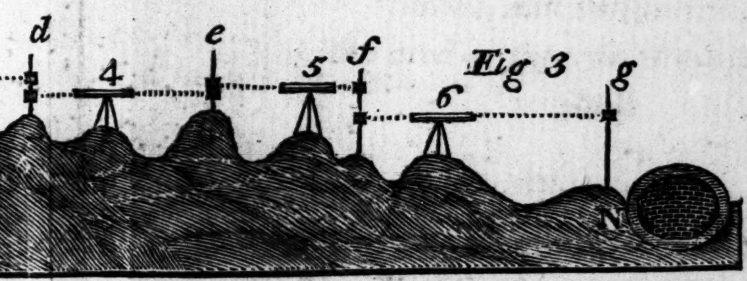


Fig 5

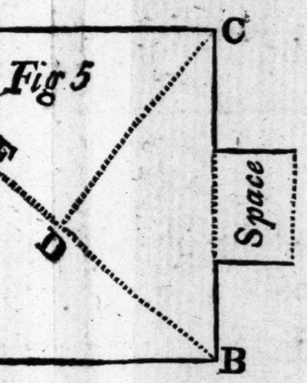
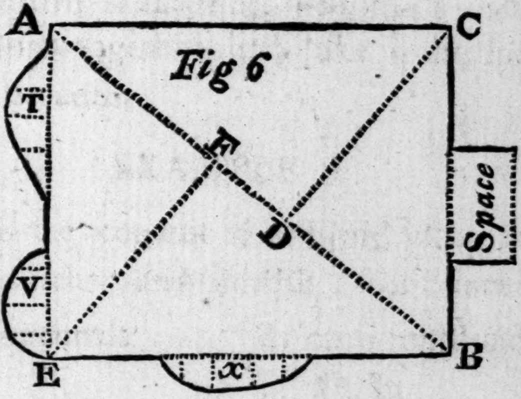


Fig 6



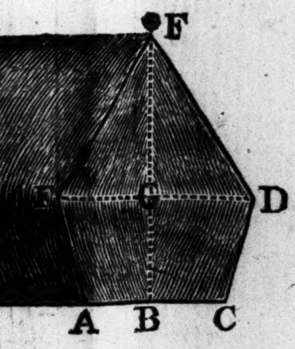
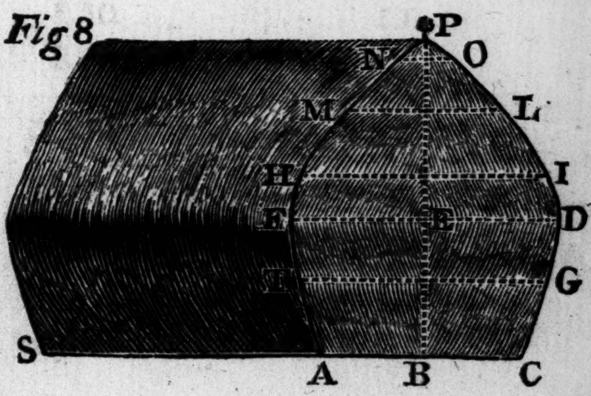


Fig 8



CHAP. IV.

Teacheth the method of meaſuring boards, round timber, and artificers work.

To find the area or ſuperficial content of a board or plank.

RULE.

Multiply the length by the breadth, and the product will be the content required; but when a board is tapering, add the breadths of the two ends together, and take ½ the ſum for the main breadth.

EXAMPLE I.

What is the content of a board whoſe length is 5 feet 6 inches, and breadth 1 foot 6 inches.

By decimals	By croſs multiplication
	Ft. In.
5.50	5.6
1.50	1.6
27500	2.9.0
5500	5.6.
8.2500 Anſ.	8.3.0 Anſ. ſq. ft.

Anſwer, 8 feet and ¼

EXAMPLE II.

What is the content of a board whoſe length is 15 feet 6 inches, and breadth 1 foot 8 inches?

By decimals	By croſs multiplication
	Ft. In.
15.50	15.6
1.66	1.8
9300	10.4
9300	15.6
1550	
	25.10 Anſ.
25.7300 Anſ. feet	

25 feet and ¾ nearly.

EXAMPLE III.

What is the content of a plank, whoſe length is 29 feet 8 inches: and breadth at one end 2 feet 3 inches, and at the other 1 foot 3 inches.

F. In.	By decimals	F. In.
2.3	29.66	29.8
1.3	1.75	1.9
2)3.8	14830	22.3.0
	20762	29.8
1.9	2966	
		51.11.0 Anſ. req.
	51.9050	

Of Round Timber.

The common way of meaſuring round timber trees when butted and headed: take the length in feet and inches, and the girt in inches about the middle length, or any where between that and the root, or butt end; (if the buyer chooſes) and this girt thus taken, divided by 4, is called the quarter girt, and is eſteemed as the ſide of a ſquare at that place where the tree was girt; therefore you muſt multiply the ſquare of the quarter girt by the length of the tree, and you will have the ſolidity of the common way.

EXAMPLE I.

If the quarter girt be 14 inches, and the length 7 feet 6 inches, what is the content?

By decimals

1.16 } ¼ girt
1.16 }
696
116
116
13456
Length 750
672800
941920
10.092000 Anſ. ſolid feet.

By croſs multiplication

F. I.
1.2 } ¼ girt
1.2 }
2.4
1.2
1.4.4
Length 7.6
8.2.0
9.6.4
10.2.6.0 Anſwer

EXAMPLE II.

The circumference of a tree in the girting place is 96 inches, and the length 16 feet 6 inches; how many ſolid feet of timber is contained therein?

	By decimals	By croſs multiplication
		F
4)96	2 2 } ¼ girt	2 2 } ¼ girt
24¼ girt	4	4
	Length 16.50	16 . 6
	Anſ. ſol con. 66.00	66 . anſ. ſolid feet

EXAMPLE III.

How many loads of timber in that tree, whoſe length is 44 feet 6 inches, and the quarter girt 3 feet 6 inches?

Note.—40 feet of timber meaſured the common way, or fifty the true way, is accounted a load, or 1 ton weight.

By decimals		By croſs multiplication
		F. In.
3.50 3.50 } ¼ girt		3 . 6 3 . 6 } girt
17500		1 . 9 . 0
10500		10 . 6
122500		12 . 3 . 0
Length 44.50	Length	44 . 6
6125000		6 . 1 . 6
4900000		539 . 0
4900000	ſolid feet	545 . 1 . 6
545.125000		

40)545(13 ton 25 feet, the area required
40
145
120
25

EXAMPLE IV.

The quarter girt 4 feet 3 inches, and the length 38 feet 6 inches, the ſolid part is required.

	By decimals	By croſs multiplication
		F. In.
	4.25 } ¼ girt	4 . 3
	4.25	4 . 3
	2125	1 . 0 . 9
	850	17 . 0
	1700	
		18 . 0 . 9
	18.0625	38 . 6
Length	3850	
		9 . 0 . 4 . 6
	9031250	686 . 4 . 6
	14450000	
	5418750	ſolid feet 695 . 4 . 10 . 6
	695.406250 Anſwer	

OF BRICKLAYER's WORK.

The work or theſe artificers is, in moſt country places, meaſured by the yard, and returned ſquare yards; for which they are paid accordingly, ſo that if the wall be brick wide, i. e. 4½ inches; 9 inches, i. e. brick length, brick and half, or two bricks, &c. in thickneſs, the workmen have ſo much more yer yard, and therefore ſuch walls muſt be meaſured ſeverally.

RULE.

Multiply the length and height together, in yards and decimal parts, and the product will be the content in ſquare yards.

Note.—There is ſeldom any deductions made for door places or windows, unleſs mentioned before the work was engaged.

EXAMPLE I.

How many ſquare yards are there in a wall, the length 47.40 yards, and breadth 5.50 yards?

```
   47.40
    5.50
 -------
  237000
 237000
 -------
260.7000
```

Anſwer 260¼ nearly

EXAMPLE II.

If each ſide wall of a building be 45 yards long on the outſide, each end wall 15 yards broad in the inſide, the height of the building 20 yards, the gable at each end of the wall 6 yards, the whole a brick and half thick, I demand how many ſquare yards is contained herein.

		Square yards	
Length eaſt ſide - - - - -	=	45	= 200
Height ditto - - - - - -	=	20	
Length weſt ſide - - - - -	=	45	= 200
Height ditto - - - - - -	=	20	
South gable breadth - - - -	=	15	= 300
Height ditto - - - - -	=	20	
North gable breadth - - - -	=	17	= 300
Height ditto - - - - - -	=	20	
Two gable ends above ſq. brea.	=	15	= 90
Height ditto - - - - - -	=	6	
Yards the true content required			2490

EXAMPLE III.

Suppoſe there is a brick wall, the length 74.50 yards, the height 4.50 yards, and 4 bricks thick;

how many yards of brick work is contained therein, i. e. 1½ brick thick,

Length 74.50
Height 4.50
372500
298000
Yards in the wall 335.2500
½ brick in thickneſs 8
3)2682.0000
Yards ſtatute 894 thickneſs the an. req.

OF PLASTERERS' WORK.

Plaſterers moſt commonly work by the ſquare yard, ſo that a decimal yard is likewiſe neceſſary to take the dimenſions of ſuch work.

Take the girt of the ſame with a ſtring, and meaſure the ſame with a yard, which enter with the name of the room; then take the height thereof, and enter it under the girt; multiply the the height by the girt, and the product will be the content.

EXAMPLE I.

Suppoſe a room meaſures in girt 45.28 yards, and the height 3.24 yards, the ceiling being 10 long and 8 broad, how many yards of plaſtering does it contain?

Girt 45.28	Ceiling long 10
Height 3.24	Broad 8
18112	ſquare yards 80
9056	
13584	
146.7072	
The ceiling 80	
Anſ. 356¾ yds. nearly 226.7072	

EXAMPLE II.

Suppoſe a room was to girt 74.50 yards, and in height 4.25 yards, the ceiling being 11 yards long and 9.25 broad, how many yards of plaſtering does it contain?

Ceiling long 11	Girt 74.50
Broad ditto 9.25	4.25
55	37250
22	14900
99	29800
Square yds. 101.75	316.6250
	The ceiling 101.75
	Anſwer 418¼ ſquare yards 418.3750

OF PAINTERS' WORK.

Painters' work is meaſured in the ſame manner as that of plaiſterers, and in taking the dimenſions the line muſt be forced into all the moulding and corners; windows are done at ſo much a piece; in carved moulding, &c. it is cuſtomary to allow double meaſure.

EXAMPLE I.

If a room be painted, whoſe girt is 97.75 yards, and height 16.50 yards, how many yards does it contain.

Girt 97.75
Height 16.50

488750
586500
97750

Anſ. 1612¾ ſquare yards 1612.8750

EXAMPLE. II.

If a room be painted, whoſe girt is 47.52 yards, and height 14.25 yards, how many ſquare yards does it contain?

47.52
14.25

23760
9504
19008

Anſ. 201¼ ſquare yards 201.9600

OF MASONS' WORK.

To maſonry belongs all ſorts of ſtone work, and the meaſure made uſe of is a foot, either ſuperficial or ſolid. Walls, blocks of marble or ſtone, columns, &c. are meaſured by the ſolid foot, and pavements, ſlabs, chimney pieces, &c. by the ſuperficial foot.

EXAMPLE I.

Required the ſolid content of a wall, whoſe length is 84 feet 6 inches, its height 15 feet, and thickneſs 2 feet.

Length 84.50
Height 15

42250
8450

1267.50
Thickneſs 2

Anſ. 2535 ſolid feet 2535.00

EXAMPLE II.

Required the ſolid content of a wall, whoſe length is 246 feet 9 inches, its height 16 feet 6 inches, and its thickneſs 2 feet 6 inches.

Length 246.75
Height 16.50

1233750
1480500
246750

40713750
Thickneſs 2.50

2035687500
814275000

Anſ. 10178½ nearly 10178.437500

OF SLATERS' AND TILERS' WORK.

In theſe works, the content of a roof is found by multiplying the length of the ridge, by the girt, from eave to eave; and, in ſlating, allowance muſt be made for the double row at the bottom.

In taking the girt, the line is made to ply over the loweſt row of ſlates, and returned up the under ſide, till it meets with the wall or eave board;

but in tiling, the line is ſtretched down only to the loweſt part, without returning it up again.

Double meaſure is generally allowed for hips, vallies, gutters, &c.; but no deductions are made for chimnies.

EXAMPLE I.

The length of a ſlated roof is 45.28 yards, and its girt 12,43 yards; what is its content?

Length 45.28
Girt 12.43

13584
18112
9056
4528

Anſ. 562¾ ſquare yards 562,8304

EXAMPLE II.

The length of a tiled roof is 74.45 yards long, and its girt 13.38 yards; what is the content?

Length 74.45
Girt 13.38

59560
22335
22335
7445

Anſ. 1096 yards 1096.1410

OF CARPENTERS' AND JOINERS' WORK.

Carpenters' and Joiners' work is that of flooring, partitioning, roofing, &c. and is meaſured by a ſquare of 100 feet.

EXAMPLE I.

If a floor be 60 feet 6 inches long, and 36 feet 6 inches broad, how many ſquares will it contain?

$$\begin{array}{lr}
\text{Length} & 60.50 \\
\text{Breadth} & 36.50 \\
\hline
 & 302500 \\
 & 363000 \\
 & 181500 \\
\hline
 & 100)2208.2500
\end{array}$$

Anſwer 22 ſquares 8¼ feet

EXAMPLE II.

Suppoſe a partition is 84 feet 6 inches long, and fifteen feet broad, how many ſquares will it contain?

$$\begin{array}{lr}
\text{Length} & 84.50 \\
\text{Breadth} & .15 \\
\hline
 & 42250 \\
 & 8450 \\
\hline
 & 100)1267.50
\end{array}$$

Anſwer 12 ſquares 67½ feet

EXAMPLE III.

If a houſe within the walls be 86 feet 6 inches long, and 42 feet 6 inches broad, how many ſquares of roofing will cover it?

```
        86.50
        42.50
      -------
       432500
      173000
     346000
     ---------
100)3676.2500
    ---------
```

Anſwer 36 ſquares 76¼ ft. will cover it

Many more examples might herein be given; but theſe already propoſed will, I hope, be thought ſufficient.

FINIS.

ERRATA.

Page

133 X ſhould have been placed where the four fields meet in one point, but is omitted through hurry.

135 line 4, for Auguſt 24, 1798, read October 24, 1797.

219 at the end of line 15, read, See fig. 9, plate 5.

Directions to the Binder for placing the Plates.

Place Plate I. facing page - - 16
Plate II. ditto - - - 58
Plate III. ditto - - - 164
Plate IV. ditto - - - 198
Plate V. ditto - - - 220
Plate VI. ditto - - - 268

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